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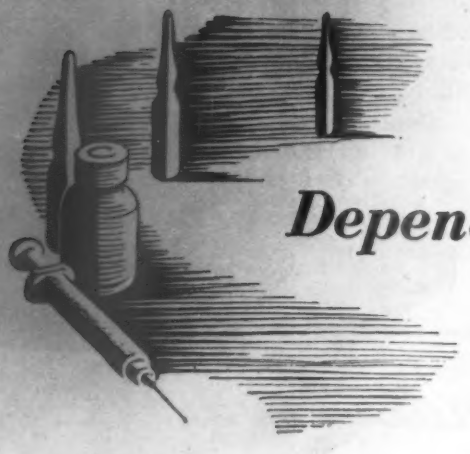

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Volume 238 MAY 20, 1948 Number 21

PORTACAVAL SHUNTS IN THE TREATMENT OF PORTAL HYPERTENSION*

With Special Reference to Patients Previously Operated Upon

ROBERT R. LINTON, M.D.†

BOSTON

A NEW chapter is being written on the treatment of portal hypertension with bleeding esophageal varices. Eck,[1] in 1877, was the first to demonstrate that the portal vein can be anastomosed to the inferior vena cava in animal experiments. From then until 1945 only a few sporadic attempts of portacaval shunts in human beings were reported in the literature. Most of these were unsuccessful, but with the recent favorable reports of Whipple[2] in 1945 and Blakemore[3, 4] in 1945 and 1947, a renewed interest has been stimulated in this subject. These authors have described two types of venous shunts to reduce the portal hypertension: an end-to-end anastomosis between the splenic and left renal veins, after a splenectomy and a left nephrectomy have been performed; and an end-to-side anastomosis between the distal end of the divided portal vein and the inferior vena cava. As a result of accumulated experience in this new surgical field it has been found that it is not possible to utilize either type of venous anastomosis in every case. This is especially true in cases in which a previous splenectomy has been done in an attempt to control the portal hypertension and bleeding from the esophagogastrointestinal tract. Furthermore, it has seemed undesirable to remove a healthy organ, such as the left kidney, unless it is otherwise impossible to make a satisfactory shunt. Accordingly, an end-to-side anastomosis between the end of the splenic vein and the side of the renal vein without nephrectomy has been developed.[5]

The purpose of this paper is to report 4 cases of portal hypertension secondary to an extrahepatic portal bed block with continued esophagogastrointestinal bleeding despite previous surgical procedures. Three patients had had splenectomies, and the other multiple operations in an attempt to control the portal hypertension.

*Presented at the annual meeting of the New England Surgical Society, Providence, Rhode Island, October 3, 1947.
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CASE REPORTS

CASE 1. L. M. (M.G.H. 21,099), a 12-year-old boy, was admitted to the hospital on December 17, 1929, because of hematemesis. He had been admitted to the Children's Hospital, Boston, in 1925 and 1927 because of similar episodes. In that institution the bleeding had stopped spontaneously after a transfusion. The most recent episode of bleeding had begun 2 days before admission.

Physical examination revealed an enlarged spleen. A diagnosis of bleeding esophageal varices due to splenic-vein obstruction (Banti's syndrome) was made. After appropriate preoperative care, a splenectomy by an abdominal approach was performed by Dr. Arthur W. Allen. The patient did well and was discharged on January 25, 1930.

He was readmitted on November 11 because of hematemesis. Operation was performed by Dr. Allen, who ligated numerous dilated veins in the gastrohepatic omentum and in the region of the left gastric vein. The patient was discharged on December 24 and was subsequently readmitted on January 15, 1931, for a tonsillectomy, on April 23, 1932, because of hematemesis, on February 14, 1937, because of hematemesis and on January 15, 1944, because of hematemesis and for an esophagoscopy and injection of the varices with 5 per cent sodium morrhuate solution. Between January 8 and July 13, 1945, the patient was readmitted five times for esophagoscopy and injection of varices. He was well until September 22, when he vomited about 500 cc. of blood. He was readmitted for a portacaval anastomosis.

At operation on October 9 the superior mesenteric vein was isolated at the base of the mesentery of the small bowel. It was divided, and the proximal end was anastomosed to the side of the inferior vena cava distal to the renal veins (Fig. 1). Biopsy showed a normal liver. The patient made a satisfactory recovery and was discharged from the hospital 15 days after the operation.

When seen on August 8, 1947, he had had no further esophagogastrointestinal bleeding and was working full time as a painter. A gastrointestinal series revealed no change in the esophageal varices. The hemoglobin was 13.9 gm. per 100 cc., and the white-cell count 9700.

CASE 2. F. L. (M.G.H. 333,628), a 16-year-old schoolgirl was admitted to the hospital on December 25, 1941, because of a sudden hematemesis of 1 day's duration. Physical examination revealed an enlarged spleen two fingerbreadths below the costal margin. A roentgenogram of the esophagus showed large esophageal varices. Liver-function tests were negative. A diagnosis of splenomegaly with esophageal varices (Banti's syndrome) was made. On January 19, 1942, a splenectomy and ligation of several large periesophageal varices were done through a transthoracic approach by Dr. Richard H. Sweet. The patient was discharged from the hospital on February 28.

She was seen occasionally in the Out Patient Department and Medical Clinic, and was well without symptoms until April 11, 1946, when she was readmitted to the hospital because of hematemesis of 1 day's duration. She was dis-

charged on May 3. The patient re-entered the hospital for a portacaval shunt on July 5. An operation on July 13 was performed through a transabdominal left subcostal incision. It was impossible to find the splenic vein, since its proximal end had become fibrosed and narrowed, and it was unsuitable for a venous anastomosis. The largest vein in the portal system that could be found was the inferior mesenteric vein, which was divided and the proximal end anastomosed to the left ovarian vein (Fig. 2). The liver biopsy was reported as normal. The patient did well and was discharged from the hospital on July 30.

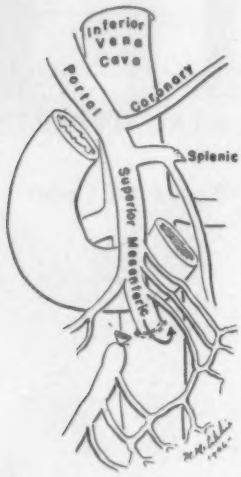


FIGURE 1. *Schematic Drawing, Showing the Anastomosis between the Proximal End of the Divided Superior Mesenteric Vein and the Side of the Inferior Vena Cava Distal to the Renal Veins.*

This type of shunt was used in Case 1, and since it was performed the patient has had no further esophagogastrointestinal bleeding for over twenty-two months.

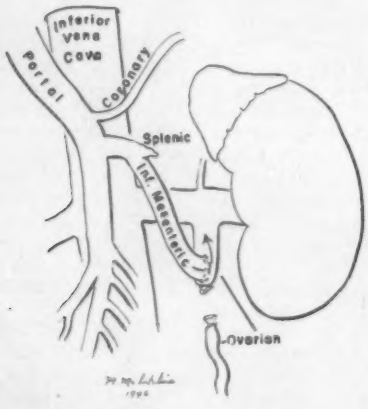


FIGURE 2. *Schematic Drawing, Showing the Anastomosis between the Proximal End of the Divided Inferior Mesenteric Vein and the Side of the Left Ovarian Vein.*

It was necessary to sever the ovarian vein because of tension on the anastomosis. This type of shunt was used in Case 2, and since it was performed the patient has had no further esophagogastrointestinal bleeding for over fourteen months.

The patient has been seen several times in the Out Patient Department and she has had no symptoms. A repeat gastrointestinal series in June, 1947, revealed the esophageal varices to be unchanged. However, she has had no further bleeding in the 14 months since the operation.

CASE 3. J. M. (M.G.H. 36), a 19-year-old male dental mechanic, was admitted to the hospital on November 6, 1935, because of tarry stools of 1 day's duration. Physical examination revealed that the liver and spleen were both slightly enlarged. A gastrointestinal x-ray series revealed extensive, large esophageal varices. A diagnosis of Banti's disease with bleeding esophageal varices was made. On December 5 the splenic artery was ligated in continuity with chromic catgut by Dr. Beth Vincent, and an extensive intraperitoneal omentopexy was performed at the same operation. The patient did well and was discharged on December 20.

On January 2, 1937, he was readmitted because of hematemesis and tarry stools of 1 day's duration. He had repeated massive hematemeses on January 18, 19 and 20, requiring eight transfusions. He steadily improved, and a second operation was performed on February 3 by Dr. Arthur W. Allen. Several large veins on the diaphragm along the lesser curvature of the stomach were ligated. The patient was discharged on March 2. He was readmitted on February 14, 1939, because of repeated tarry stools, and was discharged on March 17. He was subsequently admitted on April 28 and August 21, 1939, and February 7 and August 16, 1940, because of melena. On October 31, 1940, he re-entered the hospital for esophagoscopy, being discharged on November 6. Because of melena he was again admitted on November 7; five esophagoscopies, with injection of varices, were performed, and he was discharged on December 23. Between re-entry on January 9 and discharge on February 6, 1941, four esophagoscopies, with injections, were performed. Another episode of melena caused him to be readmitted on February 13; esophagoscopy, with injection of varices, was performed, and he was discharged on March 13. He re-entered the hospital on April 14 because of melena; esophagoscopy was performed, and he was discharged on May 2. Between May 18 and November 14 he was admitted seven times for esophagoscopy and injection of esophageal varices. At the twentieth admission, on February 5, 1942, cannulation of an intercostal vein for phlebography was attempted, the patient being discharged the next day. Between June 17 and June 26 he was readmitted because of melena. On July 25 he re-entered the hospital for a transthoracic exposure of the esophagus and ligation of several large periesophageal veins, performed by Dr. Richard H. Sweet, and was discharged on August 12. He was readmitted for 2 days on September 11 for esophagoscopy and for 9 days on November 5 because of melena. Between April 4 and May 13, 1943, he was readmitted because of hematemesis and melena. On June 14, 1943, March 17 and October 27, 1944, and March 3 and September 21, 1945, he re-entered the hospital

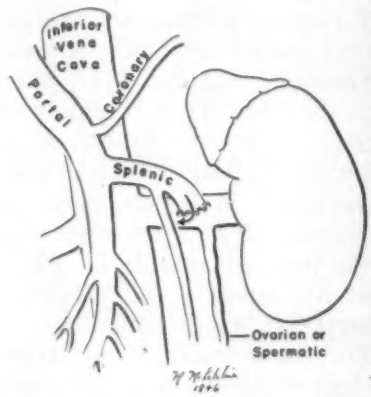


FIGURE 3. *Schematic Drawing, Showing the End-to-Side Splenorenal Anastomosis, with Preservation of the Left Kidney.*

This is the operation of choice in cases especially with a cavernomatous transformation of the portal vein, since a direct portacaval anastomosis cannot be performed in such patients. It should be performed at the same operative procedure as the splenectomy. This type of shunt was used in Case 3, and since it was performed the patient has had no further esophagogastrointestinal bleeding for over fourteen months.

for esophagoscopy and injection of esophageal varices, each admission lasting 2 days. He was readmitted on March 28, 1946, because of hematemesis, and esophagoscopy and injection of esophageal varices were performed, the patient being discharged on March 30. On April 6 he was hospitalized because of massive hematemesis of 1 day's duration. At operation on April 24, through a right abdominal incision, the portal vein could not be exposed because of the extensive hemorrhage. In the dissection the common bile duct was accidentally transected, and the cystic duct was also injured. Accordingly, a cholecystectomy and a choledochojejunostomy were performed, the latter according to Allen's[8] method. The patient made a slow but satisfactory recovery, being discharged on May 29. On June 6 he was readmitted for a final attempt at a portacaval shunt. At operation on June 8 the spleen was exposed through a left thoracoabdominal incision. It was removed with great difficulty owing to numerous vascular adhesions, including many formed as a result of the omentopexies. Considerable blood was lost, and the patient received 3000 cc. of citrated blood by transfusion from the blood bank and at least 3000 cc. of citrated blood by autotransfusion. An end-to-side suture anastomosis was accomplished between the splenic vein and the renal vein after the removal of the spleen (Fig. 3).* The renal artery was occluded for 20 minutes during the construction of the anastomosis. The operation required 6½ hours and the patient was under anesthesia for 7 hours and 45 minutes. Oliguria developed on the day after operation, persisting for several days. The blood nonprotein nitrogen gradually rose to 103 mg. per 100 cc. on the 6th postoperative day and then gradually returned to normal. At discharge from the hospital on May 29 it was 18 mg. per 100 cc., and the urine concentrated to 1.008.

The patient was last seen on August 8, 1947, when he felt well and had had no further bleeding episodes after the splenorenal anastomosis had been completed. The hemoglobin was 17 gm. per 100 cc., and the white-cell count 10,000; the urine concentrated to a specific gravity of 1.022. The nonprotein nitrogen was 27 mg. per 100 cc. The esophageal varices, however, appeared unchanged on x-ray examination.

Case 4. M. M. (M.G.H. 434,339), a 19-year-old girl, was admitted to the hospital on February 4, 1944, because of repeated episodes of hematemesis over a 5-year period. The last attack had begun 5 days before admission.

Physical examination revealed a large young woman in no acute distress. The abdomen was normal except that the spleen could be palpated three fingerbreadths below the costal margin. The liver was not enlarged. A roentgenologic examination of the gastrointestinal tract showed esophageal varices. A liver biopsy specimen obtained by peritoneoscopy was reported as showing a normal liver. A diagnosis of Banti's syndrome was made. On March 9, a splenectomy was performed through a transthoracic approach by Dr. Richard H. Sweet. The splenic vein was noted to be about 2 cm. in diameter. In addition several large periesophageal veins and the left gastric vessels were ligated. The patient was discharged on April 3.

She was readmitted on December 12 because of hematemesis. She recovered from the hematemesis rapidly, but the hospital stay was greatly prolonged because of the onset of vague abdominal discomfort and fever. A diagnosis of probable thrombophlebitis in the portal venous system was made. On June 25, 1945, an attempt was made to perform a portacaval anastomosis, but this was found to be technically impossible because of cavernomatous transformation of the portal vein. The patient was discharged on July 11. She was hospitalized in another city during September because of hematemesis. On December 11, 1946, she was readmitted for a second attempt at a portacaval anastomosis, which proved to be technically impossible, and was discharged on January 26, 1947. She was again admitted on February 23 because of hematemesis, being discharged on February 28, and on March 4 for another attempt at a portacaval anastomosis. At operation on March 10 the left upper quadrant of the abdomen was explored through a thoracoabdominal incision. An extensive search was made for the stump of the splenic vein, which could not be found despite the fact that at the time of the splenectomy it had measured about 2 cm. in diameter. Finally an anastomosis was accomplished between the proximal end of a large branch of the inferior mesenteric vein to the side of the left adrenal vein. The patient made a satisfactory convalescence, but it was believed that decompression of the pressure in the portal vein was not satisfactory because of the small diameter of the veins used in the venous shunt. She was discharged 10 days later. She re-entered the hospital because of hematemesis on July 25, being discharged on August 13, and on August 15, being discharged on September 9.

On September 17 she was readmitted for a final attempt to produce a portacaval shunt. At operation on September 20 the abdomen was opened through a long right subcostal incision. Another attempt to isolate the portal vein was fruitless, owing to the vascularity of the region and also a porky type of induration in the region of the gastrohepatic ligament. A further search was made for other venous channels to anastomose to the inferior vena cava, but none were found that would have been suitable. The patient made a satisfactory recovery, but remains in the hospital because of further esophagogastrointestinal bleeding.

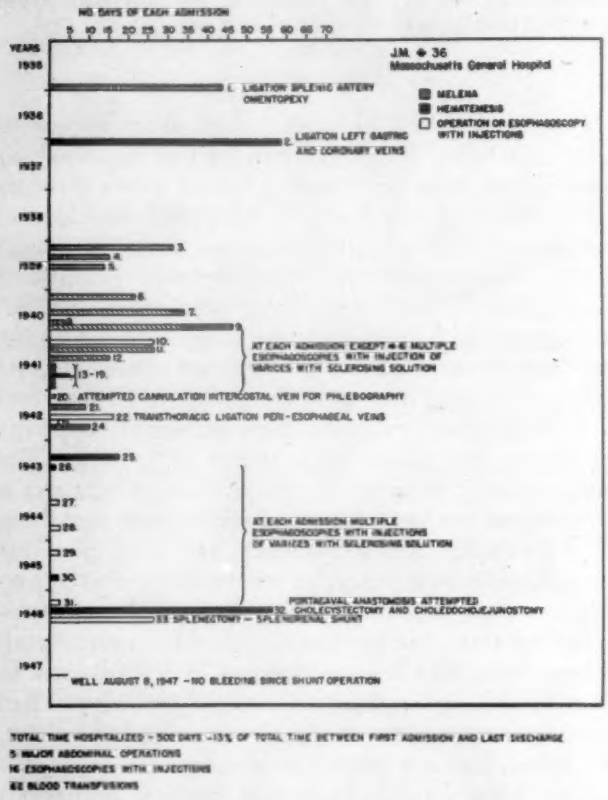
*The technic of this operation has been described elsewhere.[8]

Discussion

The construction of blood-vessel anastomoses to shunt the blood flow from one part of the body to another has been perfected in recent years through the stimulus of the work of Whipple,[2] Blakemore[4] and Blalock.[7] The results obtained with portacaval shunts in patients with extrahepatic portal-bed block (Banti's syndrome) have been extremely encouraging. In 7 cases in which a satisfactory shunt has been performed, to be reported elsewhere, no patient has bled over periods of two to twenty-two months, although roentgenologic examinations of the esophagus still show the presence of varices. The case reports presented above serve to demonstrate certain points that need emphasis in this new form of treatment. All 4 patients had had previous operations in an attempt to relieve the portal hypertension and bleeding from the esophagogastrointestinal tract, but no operation had been successful. Splenectomy had been performed in 3 cases, and in Case 3, although numerous surgical procedures had been done through both the abdomen and the chest, the spleen had not been removed.

Case 1 had a total of fourteen hospital admissions over a twenty-year period from the onset of the illness. The surgical procedures performed included splenectomy, ligation of the left gastric vein and the periesophageal veins transabdominally, five esophagoscopies, with injection of the esophageal varices with a sclerosing solution. Despite these varied forms of surgical treatment, the patient continued to bleed at intervals. The longest period of respite was from 1932 to 1937. It seems apparent, however, that none of the procedures had much effect on the portal hypertension, since at exploration in October, 1945, the pressure in the portal vein was equivalent to 47 cm. of physiologic saline solution — over four times the normal level. This case is also of interest because of the fact that the previous splenectomy precluded the production of a splenorenal anastomosis and that, owing to a cavernomatous transformation of the portal vein that made it impossible to isolate this vessel, a portacaval anastomosis could not be performed. Instead, the superior mesenteric

vein was isolated at the base of the mesentery and transected, and the proximal end anastomosed to the inferior vena cava just distal to the renal veins. This type of shunt functions because there are no valves in the portal venous system, so that blood can flow in a reverse direction into the inferior vena cava. There are sufficient collateral venous channels around the base of the mesentery to permit blood from the intestines to enter the portal system proximal to the point at which the superior mesenteric vein is interrupted and thus to gain entrance to the venous shunt. The result of this type of


NO. DAYS OF EACH ADMISSION
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1. LIGATION SPLENIC ARTERY OMENTOPEXY
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OPERATION OR ESOPHAGOSCOPY WITH INJECTIONS
AT EACH ADMISSION EXCEPT 4 & 6 MULTIPLE ESOPHAGOSCOPIES WITH INJECTION OF VARICES WITH SCLEROSING SOLUTION
20. ATTEMPTED CANNULATION INTERCOSTAL VEIN FOR PHLEBOGRAPHY
22. TRANSTHORACIC LIGATION PERI-ESOPHAGEAL VEINS
AT EACH ADMISSION MULTIPLE ESOPHAGOSCOPIES WITH INJECTIONS OF VARICES WITH SCLEROSING SOLUTION
PORTACAVAL ANASTOMOSIS ATTEMPTED
32. CHOLECYSTECTOMY AND CHOLEDOCHOJEJUNOSTOMY
33. SPLENECTOMY — SPLENORENAL SHUNT
WELL AUGUST 8, 1947 — NO BLEEDING SINCE SHUNT OPERATION
TOTAL TIME HOSPITALIZED - 502 DAYS - 13% OF TOTAL TIME BETWEEN FIRST ADMISSION AND LAST DISCHARGE
5 MAJOR ABDOMINAL OPERATIONS
16 ESOPHAGOSCOPIES WITH INJECTIONS
62 BLOOD TRANSFUSIONS

FIGURE 4. *Number and Duration of Hospital Admissions for Esophagogastrointestinal Hemorrhages and Therapy in Case 3 and Surgical Procedures Performed.*

portacaval shunt in this case is encouraging, since there has been no evidence of bleeding over a period of twenty-two months since operation. Another case, with an anastomosis of the superior mesenteric vein to the inferior vena cava, was reported by Bogoraz[8] in 1913, but with a follow-up study of only one month, according to Whipple.[2]

In Case 2 the patient had three hospital admissions. This case also demonstrates the ineffectiveness of a splenectomy and ligation of the periesophageal varices through a transthoracic approach in the treatment of portal hypertension over a prolonged period, although a respite was apparently obtained for a period of about four years. It also demonstrates the impossibility of performing a splenorenal shunt once the spleen has been removed. Whether the venous shunt that was constructed — namely, the inferior mesenteric to the left ovarian vein — will produce a satisfactory reduction in the portal hypertension for a long time, it is difficult to say. It is encouraging, however, that the patient had had no further bleeding fourteen months after operation. If further hemorrhage develops it is planned to explore the right side of the abdomen to determine if it is possible to anastomose the portal vein to the inferior vena cava, or possibly the superior mesenteric vein to the inferior vena cava.

In Case 3 eighteen of the thirty-three hospital admissions were for massive bleeding, twelve for melena, and six for hematemesis. During this period the patient had many other bleeding episodes for which he was not hospitalized. This case demonstrates the apparent effectiveness of splenectomy and an end-to-side splenorenal shunt in the control of esophagogastrointestinal bleeding from portal hypertension and the failure of other methods of surgical treatment, which included ligation of the splenic artery and an omentopexy, ligation of the left gastric and coronary veins and an omentopexy, transthoracic ligation of the periesophageal veins and multiple esophagoscopies, with injections of the esophageal varices with a sclerosing solution. The hazard of attempting a portacaval anastomosis, in the presence of the cavernomatous transformation of the portal vein, is also obvious. The common bile duct and the cystic duct were damaged, so that it was necessary to perform a cholecystectomy and a choledochojejunostomy to save the patient's life. Fortunately, he withstood this procedure, and later it was possible to do a splenectomy and an end-to-side splenorenal anastomosis. The successful outcome of the shunt operation is believed to have been due to a number of factors, chiefly, to the utilization of the thoracoabdominal approach, multiple blood-bank transfusions and autotransfusions and the preservation of the left kidney. The importance of preserving the left kidney in this type of surgical procedure cannot be too strongly emphasized, since even with both kidneys this patient developed oliguria for several days and the nonprotein nitrogen level rose to over 100 mg. per 100 cc. after the splenorenal shunt. It seems very likely that he would have succumbed to uremia if a nephrectomy had been performed. It is still too early to speak of a cure, but at least the patient has had a period of over fourteen months without bleeding, which is the longest respite that he has had since 1937.

In summary, the patient was hospitalized for a total of five hundred and two days because of the portal hypertension. This was 13 per cent of the total time elapsed from the onset of the illness to the last discharge from the hospital. While in the hospital he had five major surgical operations, sixteen esophagoscopies, with injections of sclerosing solution, and a total of sixty-two blood transfusions (Fig. 4).

Case 4, in which there were eight hospital admissions over a period of three and a half years, also demonstrates the failure of splenectomy and the ligation of the periesophageal varices to control esophagogastrointestinal bleeding, since the patient was readmitted to the hospital because of recurrent hematemesis only eight months after this operation. The case illustrates, in addition, that after a previous splenectomy it may be impossible to perform a satisfactory portacaval shunt of any type. When the spleen was removed the splenic vein was noted to be about 2 cm. in diameter, an excellent vessel with which to do a splenorenal anastomosis. At four subsequent operations it was impossible to find a suitable vessel for a satisfactory shunt. The splenic vein, which had been so large originally, had shrunk down and was replaced by innumerable smaller vessels, none of which were suitable to use. It should be pointed out that at the time the splenectomy was performed in this patient and in 2 of the others the operation of portacaval anastomosis was not a generally accepted surgical procedure. The prognosis is extremely grave, since undoubtedly the patient will continue to bleed and will ultimately succumb from hemorrhage. *In the face of these facts and the good results to date with splenorenal shunts, it seems apparent that a surgeon who does a splenectomy for portal hypertension (Banti's syndrome) should perform a splenorenal anastomosis at the same operation, since this may be the only opportunity for the anastomosis.*

Summary

Four cases are presented in 3 of which the results obtained in the treatment of portal hypertension, secondary to an extrahepatic-bed block (Banti's syndrome), by the formation of portacaval shunts were encouraging, since none of the patients with satisfactory shunts has bled since they were performed.

The most satisfactory portacaval shunt seems to be an end-to-side suture type of splenorenal anastomosis performed at the same operation at which the spleen is removed.

In some patients who have had previous splenectomies it may be possible to perform other types of portacaval shunts, such as a superior mesenteric vein to inferior vena cava or inferior mesenteric vein to left ovarian vein. Two patients have gone twenty-two and fourteen months since the shunts were performed without evidence of esophagogastrointestinal hemorrhages.

A direct portacaval anastomosis was not possible in 3 of these cases because of a cavernomatous transformation of the portal veins.

It is believed that a surgeon should not do a splenectomy in a case of portal hypertension unless he is prepared to do a splenorenal anastomosis at the same operation, since this may be the only opportunity to construct a satisfactory shunt.

A longer period of observation is necessary to determine whether the portal hypertension and the tendency to esophagogastrointestinal hemorrhages have been permanently affected.

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SALMONELLA OSTEOMYELITIS OF THE SPINE ASSOCIATED WITH ABDOMINAL AORTIC ANEURYSM*

Report of a Case

KLAUS R. DEHLINGER, M.D.†

BOSTON

THE occurrence of an abdominal aortic aneurysm and associated Salmonella osteomyelitis of the spine seems of sufficient interest to warrant a report in some detail, together with autopsy findings.

CASE REPORT

I. P., a 69-year-old married Albanian dishwasher, was admitted to the hospital on November 10, 1945. He had apparently been in excellent health until 6 days before admission, when headaches, nausea and vomiting developed and the stools became loose but not watery. After 2 days the bowel movements were apparently normal again. For the next 3 days he experienced several shaking chills with a maximum temperature of 103°F.

The past history revealed an inguinal hernia for which a truss had been worn for 20 years. A brother had diabetes.

Physical examination showed a well developed and well nourished man who was acutely ill, but oriented and in no great distress. He was flushed and perspiring freely. Scattered over the trunk, buttocks and thighs were about ten faintly erythematous, slightly indurated, nontender circinate areas, 1 to 4 cm. in diameter, which blanched somewhat with pressure and several of which had pale centers. Most of them disappeared within the first 2 hours. The heart and lungs were not remarkable. The abdomen was flaccid, with no tenderness or palpable masses. Peristalsis was active. An easily reducible left indirect inguinal hernia was present. Rectal examination revealed a moderately enlarged prostate.

The temperature was 101.2°F. by rectum, the pulse 104, and the respirations 28. The blood pressure was 122/78.

Urinalysis demonstrated a ++++ test for sugar and a +++ test for acetone. Examination of the blood disclosed a hemoglobin of 14.5 gm. per 100 cc. and a white-cell count of 10,400, with 95 per cent neutrophils. The hematocrit was 44 per cent, and the erythrocyte sedimentation rate 22 mm. in 1 hour (Westergren method). The nonprotein nitrogen was 31 mg., and the fasting blood sugar 220 mg. per 100 cc. The total serum protein was 6.0 gm. per 100 cc., with an albumin of 3.7 and a globulin of 2.3 gm. The blood Hinton test was negative. Cerebrospinal fluid, removed by lumbar puncture, was normal in every respect, including culture. Roentgenograms of the chest and abdomen, as well as retrograde pyelograms, were normal except for a moderate degree of calcification of the abdominal aorta. Both psoas outlines were straight and clear.

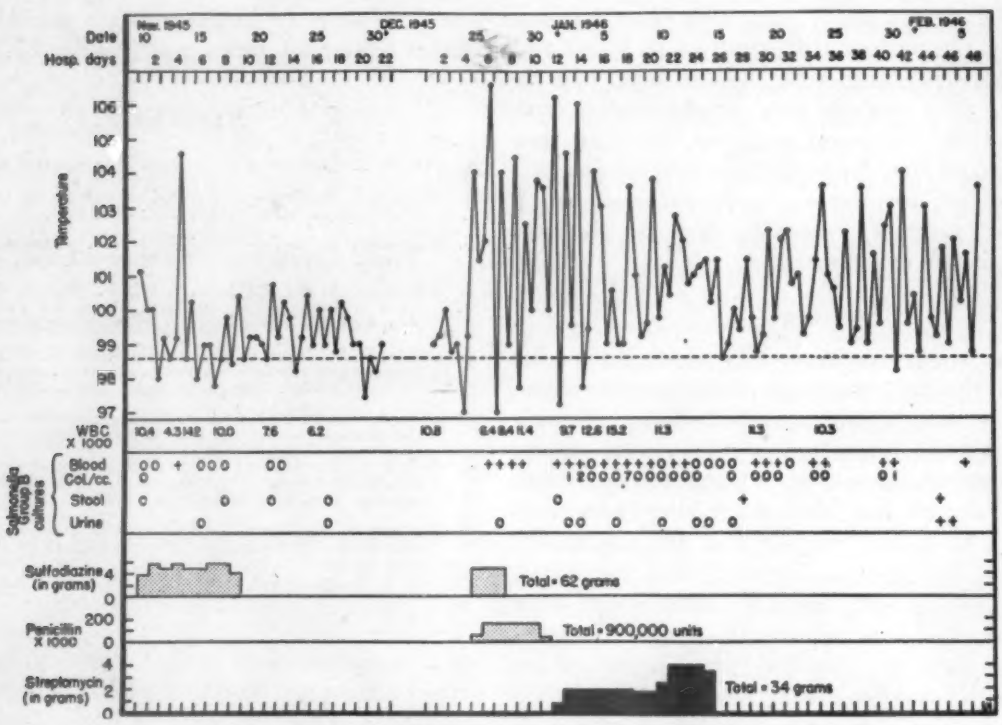

FIGURE 1. *Chart, Showing Hospital Course.*

The course in the hospital is demonstrated in Figure 1. The patient was placed on full doses of sulfadiazine. Ketonuria and glycosuria were easily controlled by small daily doses of insulin. On the 4th hospital day a shaking chill developed, and the temperature rose to 104.6°F. A blood culture taken at that time was positive for Salmonella organisms

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(Group B). Thereafter a low-grade fever continued, but no Salmonella organisms could be grown from the stool, urine or further blood cultures during the first admission. Sulfadiazine was discontinued after 9 days because of no apparent benefit.

On November 21 the blood showed specific agglutination to Salmonella organisms (Group B) in a dilution of 1:2560, the patient's own strain of organisms being used for the test. He complained of constipation, which was relieved by frequent enemas. Throughout the first hospital stay no focus of infection could be identified. The patient did not mention any back pain, but complained of discomfort in the lower part of the abdomen, which was thought to be due to the hernia, and for this reason he was transferred to the Surgical Service for a herniorrhaphy.

Two days after transfer the patient was discharged because he was considered a poor surgical risk so soon after an acute infection.

The patient was readmitted to the Surgical Service for a herniorrhaphy on December 21 because of frequent crampy pains in the region of the hernia since discharge. The stools were loose, but no diarrhea was described.

Physical examination was essentially negative except for the hernia.

The white-cell count was 10,800; other laboratory data were within normal limits. The blood Hinton test was again negative.

The temperature rose to 100°F. on the 2nd hospital day, and herniorrhaphy was postponed for this reason. Thereafter the temperature spiked daily, three times to 106°F. or over. Sulfadiazine and penicillin were given, but medication was again without apparent benefit. Microscopic hematuria was noted on several examinations. Salmonella organisms (Group B) were repeatedly obtained on blood culture. There was no evidence of an abscess of the psoas muscle roentgenographically. A barium enema was interpreted as consistent with an inflammatory process in and around the sigmoid because of marked irritability in this region noted during fluoroscopy. The patient complained of pain in the lower portion of the spine for the first time on December 27. Lumbar puncture again gave normal findings.

Because of the persistent chills and high spiking temperature he was returned to the Medical Service on December 31 for streptomycin therapy, which he received intramuscularly every 3 hours in daily divided doses of 2 gm. This was later increased to 4 gm. daily. Streptomycin was finally discontinued after a total of 34 gm. had been given over a period of 14 days because it neither freed the blood stream of Salmonella organisms nor brought the temperature to within normal levels.

At first the pain in the lower portion of the spine was present only during a spike in temperature, when it was excruciating. Later it became more nearly constant. Tenderness over the same area was elicited about 4 days after the pain had first been noted, and at about that time a few transient and faint erythematous spots, 5 mm. in diameter, were observed on the abdomen. Soon thereafter the patient complained of pain in the left knee, which became diffusely red and tender to deep pressure. Since a patellar click was absent and roentgenograms of the knee appeared normal no attempt was made to aspirate fluid. On January 4, 1946, he fell out of bed, but no known injuries resulted. At about that time he had had no bowel movements for 6 days, but good results were finally obtained with an enema.

Lateral roentgenograms of the spine on January 18 showed decalcification of the anterior surface of the third lumbar vertebra and loss of the usual lumbar lordosis. These findings had not been present on the lateral film of the spine taken 49 days previously. X-ray films on January 24 revealed further decalcification of the third lumbar vertebra anteriorly; the margins of the psoas muscles were bowed laterally, and there was an area of more or less circumscribed density anteriorly from the second to the fifth vertebra, displacing the sclerotic aorta 2.5 cm. anteriorly (Fig. 2 and 3). Films on January 29 disclosed further decalcification in the third lumbar vertebra, with extension of the process to the anterior border of the second lumbar vertebra, but the intervertebral space was not diminished. The psoas muscles showed further bulging.

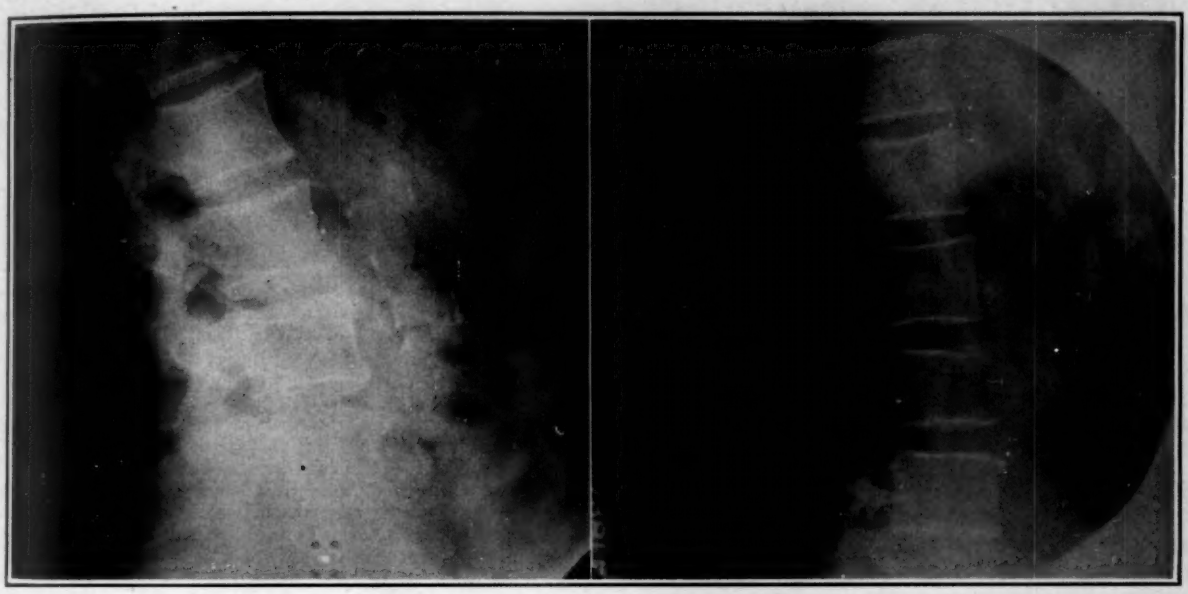

FIGURE 2. *Roentgenograms of the Spine.*

The film on the left (taken on December 1, 1945) shows a normal spine and calcification in the aorta. That on the right (taken on January 24) demonstrates a paravertebral mass displacing the aorta 2.5 cm. anteriorly, as well as decalcification of the anterior borders of the second and, more extensively, third lumbar vertebras.

A plaster cast was applied to immobilize the spine. By February 5 the patient had become incontinent of urine and feces, and required demerol for relief of pain in the joints of the extremities. He died the next evening. Blood cultures persistently grew out Salmonella organisms (Group B), which were also recovered shortly before death from specimens of both stool and urine. The patient's serum agglutinated his own organisms in a dilution of 1:5120 on one occasion. Throughout the hospital stay, the diabetes was well controlled with daily doses of 10 to 20 units of protamine zinc insulin.

At autopsy the peritoneal cavity contained no free fluid, but along its posterior wall, overlying the psoas muscles,

there was a marked fluctuant bulge that was maximal over the midline and symmetrically distributed over either side, covering an area of 18 by 20 cm. There was a well defined, left, indirect inguinal hernia that admitted two fingers. The

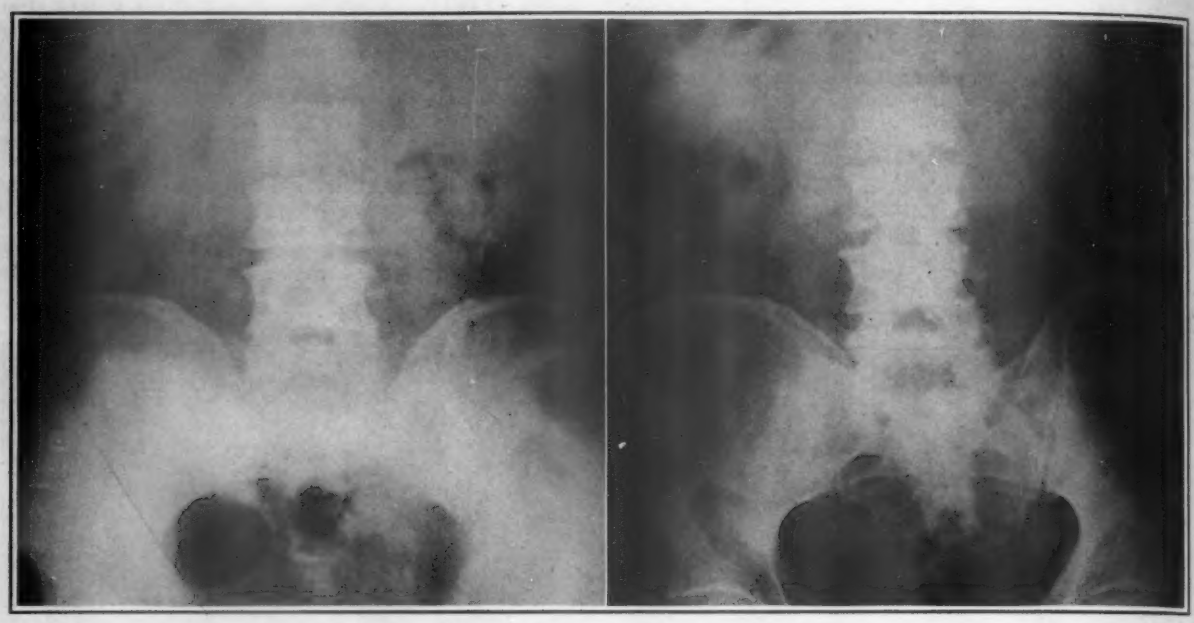

FIGURE 3. *The Film on the Left (Taken on December 1) Shows Straight Lateral Margins of Both Psoas Muscles, Whereas That on the Right (Taken on January 24) Shows Marked Bulging in Both Muscles.*

small intestine showed no evidence of ulceration, acute inflammation or strangulation. The spleen weighed 280 gm. and on cut section was deep purplish red, soft and mushy with ill defined malpighian corpuscles and markedly congested pulp. There were no verrucae or vegetations on

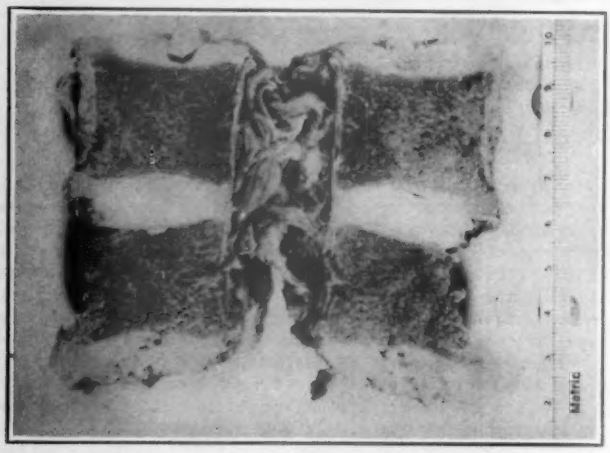

FIGURE 4. *Autopsy Specimen, Showing Destruction of the Anterior Border of the Vertebral Body, with No Narrowing and Only Slight Involvement of the Intravertebral Space Anteriorly.*

any of the heart valves. The thoracic aorta showed a mild degree of atherosclerosis, and the abdominal aorta revealed marked calcification. Overlying the third lumbar vertebra, an aneurysm protruded from the posterior wall of the aorta and extended 3.5 cm. inferiorly and laterally on either side. This aneurysmal sac consisted of adventitia and opened into the aorta over an area 4.5 by 3 cm. No point of rupture could be found, but adjacent to the aneurysm there was evidence of extensive hemorrhage into both psoas muscles. Interconnecting abscesses, filled with thick, brown, moderately foul-smelling pus lay directly posterior to the aneurysmal sac, with extensive involvement. In this area the vena cava had been invaded by a walled-off abscess, 2 by 2 cm. in diameter, which projected into its lumen as a flat polypoid mass. The anterior portion of the bodies of the second and more extensively the third lumbar vertebra were necrotic and crumbly and bathed in pus (Fig. 4). The psoas muscles were fusiform, dark purplish red and nearly twice their normal size; after fixation each measured approximately 23 cm. in length and 9 cm. in width. Multiple cross-sections showed them to be distended by an extensive blood clot, contiguous to the lateral projections of the aneurysm and measuring about 7 by 4 cm. Further sectioning of the muscles near their points of origin disclosed multiple abscesses, some interconnecting and all relatively thick walled and containing purulent material similar to that observed elsewhere. Culture grew out Salmonella organisms (Group B).

The brain was normal except for marked generalized arteriosclerosis. No other organs were remarkable.

DISCUSSION

The combination of aneurysm of the abdominal aorta and Salmonella osteomyelitis of the spine makes this a most unusual case. The latter condition has occasionally been reported in foreign journals, but no reports could be found in the American medical literature.

Infection of the spine comprises 0.2 per cent of all cases of osteomyelitis.[1] Although it is usually due to tuberculosis, typhoid being the next most frequent cause, at least in the older literature, it has been reported secondary to many infections, Schmorl and Junghanns[1] giving references to papers reporting twenty-five different etiologic organisms.

There are conflicting reports regarding the frequency of osteomyelitis as a complication of Salmonella infection. In 1382 cases of paratyphoid infection, Webb–Johnson[2] was able to recover the organism from bones or joints only twice, although many of the patients had painful joints in which the aspirated fluid was sterile. Seligmann[3] reported only 3 cases with osteomyelitis out of 1000 bacteriologically proved Salmonella infections. These were due to organisms from Group B (*Salmonella typhimurium*) and Group D (*S. enteritidis* and *S. panama*), although those in Group C (specifically *S. choleraesuis*) are supposedly more invasive for human beings. Harvey,[4] reviewing the literature on the last organism, found 15 of 71 patients (over 20 per cent) to have manifestations of involvement of the bones or joints. He did not, however, specifically state that organisms were recovered from these bones or joints. He also mentioned a current hospital case of osteomyelitis of the spine but did not report it in detail. This is the only reference of this condition found in the American medical literature. In the case reported above the Salmonella infection may have involved the knee as well as the spine, although no culture was taken of the former.

For a better understanding of the two fundamentally different types of pathologic processes in the vertebral bodies (infection and pressure erosion) an attempt is made to reconstruct the sequence of events as they occurred in this patient. It is postulated that the aneurysm of the abdominal aorta leaked out blood, providing a culture medium and finally resulting in a prevertebral abscess. The erosion of the vertebral bodies was probably started directly by the aneurysm and continued by the transmitted aortic pulsation through the prevertebral abscess, which developed between the aneurysm and the vertebras. Only later did the infection spread through the wall of the abscess and actually invade the bone. Although the evidence is incomplete, the data are all in support of this thesis.

As for the aneurysm, its origin could have been syphilitic, mycotic or arteriosclerotic.

Although aortic aneurysms are usually syphilitic, those below the renal arteries, as in the case reported, are rarely due to *Treponema pallidum*. Furthermore, this patient had several negative serologic tests for syphilis during life, and no autopsy findings were suggestive of the disease.

The possibility of a mycotic aneurysm must be seriously considered. Such aneurysms usually result from infections from within, 90 per cent being due to subacute bacterial endocarditis or subacute bacterial endarteritis, secondary to a congenital vascular anomaly such as patent ductus arteriosus or coarctation of the aorta. Stengel and Wolferth[5] collected 217 cases of mycotic aneurysm of which 187 were due to subacute bacterial endocarditis. Of the remaining 30, the authors state that 6 were "associated" with osteomyelitis, but no mention is made of which bones or vessels were involved or whether the aneurysm was adjacent to the osteomyelitis in any of the cases. Thus it is not known if the aneurysms were produced by direct extension or by infected emboli in these cases. Apparently the only reported cases of mycotic aortic aneurysms due to direct extension from osteomyelitis of the spine were in patients with Pott's disease. Interestingly enough, Klotz[6] does not refer to direct extension mycotic aneurysms due to osteomyelitis in his monograph on aneurysms, and Osler[7] does not even mention direct extension mycotic aneurysms of any kind in his long chapter on aneurysms, even though he is said to have been the first to adopt the term "mycotic."

It is unlikely that the case described above had a mycotic aneurysm from within, since there was no subacute bacterial endocarditis; however, it is not completely impossible that an infected embolus was lodged there after Salmonella bacteremia. It is also very unlikely that this was a mycotic aneurysm from without, by direct extension of the infected vertebral body, because at autopsy the wall of the aneurysm was found to consist of adventitia.

Arteriosclerotic aneurysm therefore seems the most tenable etiology in this case. Kampmeier,[8] in reviewing the literature on abdominal aortic aneurysms in 1936, collected 313 cases and added 68 more. Of these he considered "very few" to be arteriosclerotic, the great majority being syphilitic. However, more recently in other series incidences of 21 per cent (20 of 96 cases)[9] and 17 per cent (8 of 48 cases)[10] have been reported, indicating that such an etiology is not uncommon. The evidence of marked calcification of the abdominal aorta, as well as of other arteries visible in the x-ray films and at autopsy, the microscopical picture of the aorta and the patient's diabetes all support the arteriosclerotic etiology.

Erosion involving the anterior portion of the vertebral bodies and sparing the intervertebral structure is typical of external pressure as seen most commonly from aortic aneurysms, and not of an infectious process. When looked for, vertebral erosion secondary to abdominal aortic aneurysm is often seen.[8–10] Farmer[11] reported such a case with striking ante-mortem roentgenograms of the spine and pictures of the spine removed at autopsy. In the Army Medical Museum at Washington, D. C., there is a specimen of four adjacent vertebral bodies with erosion due to aortic aneurysm. The erosion may become so marked as to result in compression of the spinal cord by the aneurysm.[12, 13]

In contrast, infections of the spine do not usually begin in the central or anterior portion of the vertebral body but in the intervertebral space and adjacent bony surfaces.[14–16] The earliest x-ray changes are narrowing of the intervertebral space caused by destruction of the intervertebral tissues, as well

as questionable involvement of the adjacent bone. This narrowing is usually asymmetrical, resulting in a kyphoscoliosis and a loss of the usual lumbar lordosis, which is also due in part to muscle spasm. The reports of Salmonella spondylitis in the foreign medical literature indicate that it usually occurs in the lumbar spine and follows the typical course of any infectious spondylitis. Healing by ankylosis is the rule. Ssokoloff[16] was able to collect 5 such cases due to Salmonella, and reports of 6 others were found.[1, 12, 14, 15, 17, 18] It is interesting in passing to note the rarity of psoas abscess associated with nontuberculous osteomyelitis of the spine, which this patient had. In fact, Hesse[14] could not find a report of any such case, although the abscesses do occur in staphylococcal osteomyelitis of the spine.

Summary

A case of abdominal aortic aneurysm and adjacent Salmonella osteomyelitis of the spine with autopsy findings is reported.

An attempt is made to analyze the sequence of events occurring in this case.

It is concluded that the abdominal aortic aneurysm was primary and arteriosclerotic in origin, whereas the Salmonella osteomyelitis of the spine developed secondarily.

A review of the literature reveals that Salmonella osteomyelitis of the spine is very uncommon, and this is apparently the first case in which either aneurysm or psoas abscess was found associated with this condition.

Streptomycin, given over fourteen days in a total dose of 34 gm. apparently had no effect whatsoever on the Salmonella infection.

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BONE AND JOINT PAIN IN LEUKEMIA, SIMULATING ACUTE RHEUMATIC FEVER AND SUBACUTE BACTERIAL ENDOCARDITIS*

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ALTHOUGH pain along the bones and in the joints in the acute leukemias has been reported in the literature from time to time, its diagnostic significance has not been sufficiently stressed, and its confusion with acute rheumatic fever has been the rule rather than the exception. This confusion has depended to a large extent upon the many similarities in the symptomatology of the leukemias and rheumatic fever. In either of these conditions there may be asthenia, palpitation, dyspnea on exertion, epistaxis, fever, bone and joint pain, abdominal pain, pallor, purpuric manifestations, lymphadenopathy, splenomegaly, anemia, tachycardia, accentuation of the heart sounds and cardiac murmurs. Additional diagnostic difficulties arise in the early stages of leukemia when lymphadenopathy, splenomegaly, hepatomegaly and a clear-cut blood picture may be absent. The importance of a correct diagnosis can be appreciated especially from the standpoint of management and prognosis.

Although it is not our purpose to review the entire literature pertaining to this subject, mention of a few of the outstanding contributions is made. That pain and tenderness along the bones and in the joints constitute a prominent feature of the symptomatology of the leukemias was pointed out as early as 1889 by Ebstein[1] and 1895 by Fraenkel.[2] In 1913 Strauch[3] again mentioned that in some cases of acute lymphatic leukemia the onset is marked by pain and swelling of the joints, resembling articular rheumatism. Seward[4] reported a case in a thirty-one-year-old man who died of lymphatic leukemia and who presented during life severe pain and swelling of the hips and shoulders. Poynton and Lightwood[5] described a case in a three-and-a-half-year-old girl with acute lymphatic leukemia and multiple, migratory joint pain recorded as "flitting from joint to joint," and involving the ankles, knees, wrists and fingers. In a series of 28 cases of leukemia in children reported by Wollstein[6] pain over the bones occurred in 10. In a larger series studied by Cooke[7] 13 out of a total of 50 patients had "rheumatoid pain," which was the most prominent symptom in 6 cases. Baldridge and Awe[8] found acute arthritis in 13 of 20 patients under twenty-one years of age with lymphogenous leukemia. Similar reports have appeared by Smith,[9] Sutton and Bosworth,[10] Conybeare[11] and others. It is interesting to note that in the majority of the reported cases the diagnosis of rheumatic fever was originally made.

The coexistence of leukemia and rheumatic fever has been regarded as extremely rare. Ehrlich and Forer[12] reported a fatal case in an eleven-year-old girl with acute myelogenous leukemia, who presented pain, tenderness, redness and swelling about the joints, so that the condition seemed indistinguishable clinically from acute rheumatic fever. At autopsy the heart showed both leukemic infiltration and Aschoff bodies. No similar case, according to the authors, was found in the literature.

Occasionally, the articular manifestations of the leukemias simulate rheumatoid arthritis. This is particularly so in patients presenting fusiform swelling of the proximal interphalangeal joints of the fingers. Such cases have been reported by Karelitz[13] and Flinn.[14] Differentiation from Still's disease, which may be accompanied by generalized enlargement of the lymph nodes and by splenomegaly, is important in children.

Forkner[15] has classified bone and joint involvement in the leukemias under the following headings: tumor-like lesions of bones in chloroma; tumors of leukoblastic origin in bones and destructive and absorptive lesions leading to softening, defects and fractures; periosteal elevations, particularly about the joints; arthritis, often of the acute recurrent type, more rarely of the chronic infectious type; osteosclerosis of the bone marrow; and osteomyelitis. Some overlapping of these categories frequently occurs. Patients with acute arthritis, for example, often show periosteal elevations on x-ray study.

Pathologically, apart from tumor formation, leukemic infiltration has often been demonstrated in cases showing periosteal elevations. However, not all patients who exhibit joint pain during life present articular changes on pathological examination. In the report by Seward[4] of severe joint pain during the course of lymphatic leukemia no gross or microscopical abnormalities of the joints were found on post-mortem study. Baldridge and Awe[8] were able to demonstrate lymphoblastic infiltration of bone in 1 of 55 cases of lymphogenous leukemia and in 1 of 14 cases of subleukemic lymphogenous leukemia.

This report presents 4 cases of acute lymphatic leukemia in which bone and joint pain were outstanding features. In 2 cases a diagnosis of acute rheumatic fever was made at the time of admission to the hospital. In a third case the findings so

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closely resembled those of subacute bacterial endocarditis that this diagnosis was made on entry. The fourth case was correctly diagnosed on admission, but it is interesting to note that the referring physician considered the symptoms rheumatic in origin. These cases fall into the fourth (arthritic) category of Forkner,[15] cited above.

Case Reports

Case 1.* J. G. (R.B.B.H. 1849), a 7-year-old girl, was admitted to the hospital on July 18, 1939, with a complaint of pain and tenderness in the right knee of 4 weeks' duration. She had had several episodes of migratory joint pain, involving the knee, elbows and ankles and the cervical and lumbar areas of the spine. On one occasion the right elbow joint had remained swollen for 3 days. She also complained during this period of recurring, transient, right-lower-quadrant pain associated with nausea and on several occasions with vomiting. There had been a slight nonproductive cough. The temperature had varied between 99 and 100°F., and the pulse between 100 and 140.

An aunt was said to have a "leaking valve," and another was known to have definite rheumatic heart disease.

On physical examination the patient did not appear to be acutely ill. There was a slight malar flush. No lymphadenopathy was present. Examination of the heart showed no enlargement, a forceful apical beat and a reduplicated pulmonic second sound. There were no murmurs or thrills. The tip of the spleen was palpable at the end of deep inspiration. The right knee was painful on motion, permitting flexion to 90°.

The temperature was 99.5°F., and the pulse 135. The blood pressure was 105/75.

Examination of the blood disclosed a red-cell count of 4,560,000, with a hemoglobin of 80 per cent, and a white-cell count of 5550, with 49 per cent neutrophils, 50 per cent lymphocytes and 1 per cent basophils. The platelets appeared normal in number.

During the hospital stay the patient experienced several episodes of fleeting joint pain involving the elbows, knees and ankles. She also complained frequently of lower abdominal pain, associated at times with nausea and vomiting. At the end of 10 weeks the liver and spleen were readily palpable, and the blood revealed the development of a moderate secondary anemia. There was a progressive rise in the percentage of lymphocytes and a fall in the number of platelets. Because of the progressive anemia, blood transfusions were resorted to. This procedure aided in maintaining the hemoglobin level between 80 and 85 per cent and the red-cell count between 4,000,000 and 4,500,000. The white-cell count varied between 4000 and 5000. On smear 90 per cent of the cells were lymphocytes. Fourteen weeks after admission purpuric spots appeared over the body, and a few large ecchymoses were noted. The cervical, axillary and inguinal nodes became enlarged. The hemoglobin level had fallen to 57 per cent, the red-cell count to 3,610,000, and the platelet count to 58,000. At the end of 16 weeks there was a further drop in the hemoglobin to 35 per cent, in the red-cell count to 2,080,000 and in the platelets to 15,000. The white-cell count was 3950, and on smear only lymphocytes were seen, of which 60 per cent were classified as large and the remainder as blast and atypical forms. Considerable bleeding from the gums took place, and on one occasion hematemesis occurred. Terminally there were repeated convulsions, and the respiratory rate reached 68 per minute, and the pulse rate 160 per minute. The patient died approximately 18 weeks after admission.

Permission for autopsy was not obtained.

Case 2. J. MacR. (B.C.H. 862,131), a 19-year-old boy, was admitted to the hospital on June 1, 1937. He had been well until 8 weeks before entry, when he had experienced episodes of vomiting continuing over a period of 4 weeks. Four weeks prior to admission he had complained of steady pain in the right shoulder and in the joints of the right foot, the latter associated with local swelling and tenderness and severe enough to make weight bearing impossible. On the day of entry he had had two moderately severe nosebleeds.

Except for vague muscular pains during the last year, the past history was noncontributory.

On physical examination the skin and mucous membranes were moderately pale, but otherwise not remarkable. Venous and arterial pulsations in the neck were very prominent. The throat was injected. The heart sounds were of booming quality, with accentuation of the pulmonic second sound. A loud, harsh, systolic murmur was heard along the left border of the sternum, best at the second left interspace. The liver and spleen were not palpable. There was slight local swelling, redness and heat over the bones of the right foot, with definite tenderness on pressure. Examination of the right shoulder was negative.

The temperature was 99.6°F., and the pulse 90. The blood pressure was 120/64.

Examination of the blood revealed a red-cell count of 2,050,000, with a hemoglobin of 38 per cent, and a white-cell count of 13,400, with 48 per cent neutrophils, 50 per cent lymphocytes and 2 per cent monocytes.

Because of the marked anemia the patient received several blood transfusions, with little response in either the hemoglobin level or the red-cell count. He continued to have repeated, moderately severe nosebleeds while on the ward. He complained considerably of pain in the joints of the right foot and later of generalized joint pain, especially marked in the left elbow, which had become moderately swollen and very tender to touch. The value for blood uric acid was 18.5 mg. per 100 cc. On the 23rd hospital day the white-cell count was 7600, and the smear showed 50 per cent lymphocytes. The liver and spleen were now palpable, and their size increased rapidly up to the time of death. On the 29th day the white-cell count had risen to 144,000, with 99 per cent lymphocytes, mostly immature forms. There was generalized enlargement of the lymph nodes. Acute ulcerations of the mucous membranes of the mouth developed, and the patient died suddenly on the 37th hospital day.

Autopsy† revealed leukemic infiltration of the spleen, liver, kidney, anterior mediastinal connective tissue, lymph nodes, and lumbar, sternal, femoral and tibial bone marrow. Small collections of lymphocytes were found in the synovia of the left elbow joint. The renal tubules were packed with deposits of uric acid.

Case 3. R. C. (B.C.H. 919,897), a 15-year-old schoolboy, was admitted to the hospital on November 11, 1938. One month before entry migratory joint pain involving the right knee, left ankle, wrists and elbows had developed. The joints were warm, painful on motion and tender to touch, but not remarkably swollen. These symptoms persisted for 1 week, after which he noticed progressive pallor of the skin. He became feverish, and for the first time experienced night sweats. Two weeks after the onset of the illness he complained of soreness of the finger tips, aggravated by pressure. On the day prior to entry he had an episode of sudden blurring of vision in the left eye, which rapidly cleared up. Except for palpitation, he offered no additional complaints.

Physical examination disclosed a patient who appeared acutely ill. The skin had a definite café au lait color. The throat was moderately injected. The apical beat was diffuse and forceful, and the left border of cardiac dullness was percussed just outside the midclavicular line. The heart sounds were rapid and booming, and the pulmonic second was greater than the aortic second sound. A loud, blowing systolic murmur was heard at the apex. The spleen was felt two fingerbreadths below the left costal margin. The liver was not palpable. A few, small cervical, axillary and inguinal nodes were found. There were no petechiae. The joints were normal.

The temperature was 101°F., and the pulse 120. The blood pressure was 108/72.

Examination of the blood showed a red-cell count of 1,520,000, with a hemoglobin of 30 per cent, and a white-cell count of 3800, with 10 per cent neutrophils, 16 per cent small lymphocytes, 6 per cent large lymphocytes, 67 per cent lymphoblasts and 1 per cent monocytes. The platelet count was 45,000. Repeated blood cultures were negative. An electrocardiogram was interpreted as indicative of myocardial damage. X-ray examination of the chest was negative.

*We are indebted to Dr. Marshall G. Hall, of the Robert Breck Brigham Hospital, for permission to report this case.

†Boston City Hospital No. 37-464.

The course was progressively downhill. On the 2nd hospital day considerable hemorrhage occurred from the gums, and on the 3rd day there was a retinal hemorrhage in the left eye. Repeated blood transfusions had no effect on the hemoglobin level or the red-cell count. The white-cell count rose to 20,000 on the 3rd day, and fell to 4200 by the 6th day. The temperature remained elevated throughout the illness and was septic in type. The patient died on the 18th hospital day. The white-cell count prior to death was 3800, with no essential changes in the blood smear.

Permission for autopsy was not obtained.

Case 4. M. W. (B.C.H. 870,403), a 14-year-old Negress, was admitted to the hospital on August 19, 1937, too ill to give a satisfactory history. From the mother it was learned that the patient had complained for the past year of weakness and fatigability. For 7 weeks prior to admission there had been considerable joint and muscle pain, and for 4 weeks slight, intermittent bleeding from the nose and gums. Three months previously she had had a severe sore throat, which had improved after 1 week. Amenorrhea had been noted for the last three months.

Physical examination disclosed a patient who appeared acutely ill, complaining mostly of abdominal pain. The mucous membranes were very pale. There was evidence of recent bleeding from the gums. The tonsils were red, large and ulcerated. A few, small, nontender lymph nodes were felt in the neck. Moist rales were heard at both bases. The heart sounds were of booming quality, and a loud systolic murmur was heard at the apex. The liver edge was palpated six fingerbreadths, and the spleen three fingerbreadths below the costal margin. A round, tender mass was felt suprapubically, consistent with a pregnancy of 4 months' duration.

The blood pressure was 110/58.

Examination of the blood showed a red-cell count of 1,330,000, with a hemoglobin of 28 per cent, and a white-cell count of 278,000. The white cells on smear were predominantly immature lymphocytes. There was a marked reduction in the number of platelets.

During the brief hospital stay the patient complained of constant, generalized abdominal pain. She died suddenly, approximately 15 hours after admission.

Autopsy* revealed leukemic infiltration of the spleen, liver, pancreas, stomach, ileum, kidney, adrenal glands, ovaries and uterus and vertebral, costal, sternal, femoral and tibial bone marrow, as well as lymph nodes throughout the body. The joints were not examined. The uterus contained a fetus estimated to be 18 weeks old, whose tissues were free of leukemic invasion on microscopical examination.

Discussion

The cases presented above illustrate very clearly the similarities in the symptomatology and physical signs, at certain stages, of leukemia, acute rheumatic fever and subacute bacterial endocarditis. Although numerous reports in the literature demonstrate the similarities between leukemia and acute rheumatic fever, little reference to the difficulty in differentiating leukemia from subacute bacterial endocarditis is to be found. However, the fact that confusion between these two diseases has occurred is brought out in the following statement by Herrick[16]:

> I do not remember to have seen malignant endocarditis mistaken for acute leukemia, but I have seen the latter looked upon as malignant endocarditis. The fever, rapidly developing anemia, the hemorrhagic lesions in the skin, the enlarged spleen and a loud endocardial murmur may make the resemblance quite strong. . . .

The various symptoms and signs common to these illnesses may be listed as weakness, fatigability, weight loss, fever, sweats, bone and joint pain, muscle pain, painful fingertips, abdominal pain, anorexia, vomiting, epistaxis, pallor, shortness of breath, palpitation, anemia, hemorrhagic skin lesions, tender, warm, swollen joints, lymphadenopathy, splenomegaly, tachycardia, accentuation of heart sounds and cardiac murmurs. Certain clinical findings merit further comment regarding differential diagnosis.

*Boston City Hospital No. 37-542.

Blood Picture

It should be remembered that anemia and thrombocytopenia are not essential features of the early stages of leukemia. Hence, the finding of normal values for hemoglobin and normal counts for red cells and platelets does not exclude leukemia as a diagnosis. This is clearly demonstrated in Case 1, in which the hemoglobin was 80 per cent, the red-cell count 4,560,000 and the platelets normal a month after the onset of symptoms. Later in the course of the disease anemia and thrombocytopenia become prominent, attaining a severe grade in most cases. The degree of anemia, when present, is only of limited value in differential diagnosis. According to Wilson[17] secondary anemia is usually present during rheumatic activity, and its degree parallels the severity and duration of the disease. In a series of cases from the New York Hospital the average red-cell count was 3,700,000, and the range from 2,800,000 to 4,500,000. The anemia is usually not severe enough to warrant blood transfusions, unless repeated and severe nosebleeds have occurred. In the presence of profound degrees of anemia and findings simulating acute rheumatic fever leukemia must be considered in the differential diagnosis. Cases 3 and 4 illustrate this point, the red-cell count in the former having been 1,500,000 and that in the latter 1,300,000 at the time of admission to the hospital. The difficulty in differential diagnosis based on this point, however, is well shown by Case 2, in which repeated and severe epistaxes occurred and in which the red-cell count on admission was 2,050,000. That diagnosis cannot always be made on a single finding is again brought out by Poynton's[18] mention of a rare case of rheumatic fever in which the anemia proved fatal. Severe anemia in rheumatic fever has also been reported by Hubbard and McKee.[19]

The response of the anemia to blood transfusion is not in itself diagnostic. Although, generally speaking, the anemia in leukemia does not respond readily to this procedure, especially in the presence of hemorrhage, a fair response may be obtained in the early stages of the illness, as in Case 1, in which the hemoglobin level was brought up from 63 per cent to 85 per cent within a period of three weeks. Later in the course of the disease transfusions were of no avail.

The presence or absence of leukocytosis may be of some aid in diagnosis. Leukocytosis is the rule in cases of active rheumatic fever associated with

joint pain.[20] The average white-cell count, according to Wilson,[17] is 13,200, the range being from 8000 to 23,000. In 91 per cent of her cases the white-cell count was over 9000. Consequently, the presence of leukopenia associated with symptoms referable to the bones and joints should make one suspect conditions other than acute rheumatic fever. The differential count is of great importance. Ordinarily, there is a rise in the percentage of neutrophils during active rheumatic fever.[20] The finding of lymphocytosis, especially when associated with leukopenia, is presumptive evidence against rheumatic fever, even though the clinical manifestations point to that diagnosis. Cases 1 and 2, both of which presented leukopenia and moderate lymphocytosis, were erroneously considered to be acute rheumatic fever at first. No difficulties arise in differential diagnosis when the blood picture is what is usually considered more typical of leukemia.

Joint Pain

Any group of joints may be involved in either leukemia or acute rheumatic fever. The clinical features of one may be indistinguishable from those of the other. There may be transient arthralgias, migratory joint pain, persistent pain in one or more joints and all the local manifestations of heat, redness and swelling. The response of the joint pain to salicylates does not help in distinguishing one disease from the other. Although cases have been reported in which salicylates have failed to relieve the joint pain in leukemia,[21] the patient in Case 1 obtained definite benefit from them.

The determination of the level of blood uric acid may be of decided value in the differential diagnosis of the two diseases. In conditions like leukemia, in which there may be considerable destruction of blood and liberation of nucleoproteins, the value for blood uric acid may become elevated, in some cases markedly so. The blood level in Case 2 was 18.5 mg. per 100 cc., and at post-mortem examination the renal tubules were packed with deposits of uric acid. Hench[22] brought out the point that the acute arthritis in leukemia should be suspected as gouty. Unfortunately, values for uric acid were not obtained in the other cases reported above. Hyperuricemia is not present in acute rheumatic fever.

X-ray Films of Bones and Joints

Numerous reports have appeared in the literature concerning bone and joint changes as visualized by x-ray examination in cases of leukemia. An excellent review of the literature on this subject is presented by Connor.[23] Among the changes noted were subperiosteal elevation, osteosclerosis, osteoporosis, cortical stratification, rarefaction at the ends of the long bones, spontaneous fractures, large tumor masses in the upper ends of the long bones, various osteolytic lesions and medullary striations. These lesions are produced essentially by the encroachment of leukemic cells on the normal bony structures. All cases of leukemia, however, do not show bone changes on x-ray study. In a review by Wollstein[6] of 10 cases of leukemia in children presenting bone and joint pain as a symptom, x-ray evidence of bone changes was found in 6, consisting of cortical destruction, rarefaction and periosteal elevation. X-ray studies of all the bones in Case 1, taken eight weeks after the onset of the illness, were entirely negative. The commonest x-ray finding is periosteal elevation. It should be realized that this abnormality is far from specific for the leukemias. It may be seen in a number of different conditions, among them osteomyelitis, scurvy, congenital syphilis and bone tumors. The cause of pain in the joints and along the bones in cases of leukemia is generally attributed to the invasion of the bony and articular structures by leukemic cells, although such invasion has not been consistently demonstrated. No satisfactory explanation why this symptom is more frequent in younger patients has been given.

In conclusion it is emphasized that the presence of bone and joint pain, apart from that of traumatic origin, in young people does not invariably mean acute rheumatic fever. The differential diagnosis of this symptom should include a consideration of many conditions, among them undulant fever, poliomyelitis, osteomyelitis, scurvy, rickets, syphilis, gonorrhea, tuberculosis, Haverhill fever, Hodgkin's disease and Still's disease. A discussion of the differential diagnosis of these conditions is beyond the scope of this paper. We have simply attempted to demonstrate the similarity in the symptoms and signs of leukemia and acute rheumatic fever, and to point out certain features that may be of value in their differential diagnosis, especially in the earlier stages of leukemia when the usual typical features may be lacking.

Summary

Four cases of acute lymphatic leukemia, 3 presenting signs and symptoms simulating those of acute rheumatic fever and 1 simulating those of subacute bacterial endocarditis, are presented.

Certain pitfalls and aids in the differential diagnosis between acute rheumatic fever and acute lymphatic leukemia are discussed.

Complete examination of the blood should be performed routinely in all cases presenting bone or joint pain as a symptom.

The findings that point to the diagnosis of lymphatic leukemia rather than of acute rheumatic fever are leukopenia persistent in the presence of an active clinical course, leukopenia or leukocytosis associated with an increase in the percentage of lymphocytes and bone changes on x-ray examination.

The various bone changes in leukemia visible by x-ray study are enumerated.

The importance in differential diagnosis of other disorders that cause bone and joint pain in young people is mentioned.

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MEDICAL PROGRESS

ORTHOPEDIC SURGERY

II. Growth and Inequality of Leg Length in Poliomyelitis*

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BOSTON

ALTHOUGH it is not the purpose of this paper to consider in detail the general factors that as a rule affect equally the growth of both limbs, a few words about normal growth may not be amiss.

Nature produces regularly in the human being, as in many other animals, paired, symmetrical, mirror-imaged extremities of essentially identical length. These normal growth processes are complex and dynamic, beginning with the union of an ovum and a sperm, which carry in their chromosomes the hereditary factors (genes) that determine whether the person will have the muscular legs of an athlete, the shapely limbs of the chorus girl or the misshapen contours of the achondroplasic dwarf.

Added to the hereditary are many environmental factors that affect normal development. The diet of the pregnant mother[1, 2] and of the child during its whole growing period is of great importance.[3] Vitamins, proteins, minerals and carbohydrates are needed in adequate amounts. The pituitary, thyroid, adrenal and other glands of internal secretion furnish hormones that directly or indirectly play an important role in determining the physical characteristics of the person and of his lower extremities.

The over-all length of the lower limbs consists in the length of the femur and tibia, with some minor increments represented by the articular cartilage of the hip, knee, ankle and subastragalar joints and by the bones of the hind foot (os calcis and talus).

Longitudinal growth of the long bones is the result of the highly specialized activity of the epiphyseal plates. Cartilage cells arranged in columnar fashion multiply, pushing the epiphysis at either end of the bone away from the diaphysis. At the same time the older cells of the epiphyseal plate nearest the diaphysis maturate and are replaced by bone. Thus, during the growing period, the cartilage plate maintains an approximately constant thickness while the shaft of the bone increases in length. At some time in adolescence the growth potential of the epiphyseal plate becomes exhausted; the cartilage cells reach senescence and die, and the diaphysis unites with the epiphysis, leaving at most a faint transverse x-ray shadow to indicate the site of the epiphyseal plate. According to Green[4] the average skeletal age for cessation of longitudinal growth of the femur and tibia is fourteen years and three months in girls and sixteen years and three months in boys. There are wide variations from this average, which become less pronounced if true skeletal age is substituted for chronologic age. For the determination of skeletal age, the work of Todd[5] on skeletal maturation has given a reasonably satisfactory set of standards.

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There is cessation of growth long before fusion of the epiphysis and diaphysis occurs. Although x-ray films may show the epiphyseal line to be open, all growth from that cartilage plate may have ceased.

The epiphyseal plates of the femur and tibia do not contribute equally to the longitudinal growth of the lower extremity. Although exact values derived from observation of a large series of cases are not available, the figures presented in Table 1 appear to be reasonably accurate.

TABLE 1. *Contribution of Femoral and Tibial Epiphyses to Longitudinal Growth of the Lower Extremity.*

EPIPHYSIS	BONE LENGTH CONTRIBUTED		APPROXIMATE LEG LENGTH CONTRIBUTED
	%*	%†	%‡
Proximal femur	30	30	16
Distal femur	70	70	39
Proximal tibia	55	56	25
Distal tibia	45	44	20

*According to Gill and Abbott.[6]

†According to Green and Anderson.[4]

‡Calculated from Green and Anderson.[4]

UNEQUAL GROWTH

Many conditions may result in asymmetrical growth and unequal length of the legs. These conditions may be classified in three main groups: growth retardation due to local interference at an epiphyseal plate; growth retardation due to interference from remote causes; and factors that may stimulate unilateral growth.

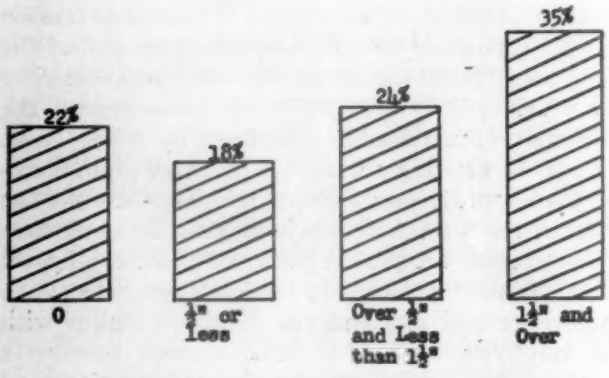

FIGURE 1. *Incidence of Discrepancy in Leg Lengths among 371 Cases of Poliomyelitis in Which the Onset Occurred before the Age of Sixteen Years.*

Local Interference at an Epiphyseal Plate

Congenital abnormalities of the epiphyseal plate, tumors, infections and trauma are some of the more important types of pathologic processes that can directly impair the ability of an epiphyseal plate to keep pace with its counterpart.

A few children are born with congenital abnormalities in which one or more epiphyseal plates are absent or deficient. Osteomyelitis or tumor may invade an epiphyseal plate, destroying the cartilage cells and thus causing unequal growth. A fracture through an epiphysis may cause premature union of the epiphysis, with resultant shortening of the extremity.

Interference from Remote Causes

Any process that results in unequal motor power in the two extremities may cause unequal growth. Poliomyelitis is the most important member of this class, which also includes spastic, obstetric and traumatic nerve palsies. The flaccid paralysis of poliomyelitis, obstetric and traumatic nerve lesions is associated with much more shortening than is found in spastic paralysis.

Disuse is a potent cause of growth retardation. Prolonged immobilization of an otherwise normal extremity may cause retardation of growth and premature ossification of normal epiphyseal plates. Numerous observers have noted that tuberculosis of the hip treated by prolonged immobilization of the whole extremity in a plaster cast results in extreme atrophy and shortening of up to 4 or 5 inches. Recently, attention has been called to the fact that this may be due to premature closure of the epiphyses about the knee.[7, 8]

Another example of the effect of unilateral immobilization on growth may be cited. Cases of unilateral Legg–Perthes disease, treated by prolonged bed rest but with little or no immobilization of either extremity, recover with minimal shortening — usually not exceeding 1 cm. This minimal shortening is probably due to local interference with growth at the proximal femoral epiphysis. But a similar series of cases, in which the affected leg was protected by a nonweight-bearing brace for an equally prolonged period, showed more shortening (1 to 3 cm.) than those treated by bed rest. It is well known that growth and form are directly influenced by function. It is therefore equally true that disuse or restricted use of one extremity will adversely affect its development.

Unilateral Growth

Unilateral stimulation of growth occurs rarely. The conditions in which it most often occurs are osteomyelitis, vascular tumor such as hemangioma, arteriovenous fistula and fracture of the diaphysis of growing bones. The common denominator appears to be increased blood supply to the affected ex-

tremity, giving a favorable environment for rapid growth of the epiphyseal plates.

Effect of Poliomyelitis on Growth of Lower Extremities

In the preparation of this paper, the records of 700 cases of infantile paralysis treated in the Out Patient Department of the Massachusetts General Hospital were reviewed. Of 371 cases in which the onset was before the age of sixteen, 41 per cent had ½ inch or less of shortening, 24 per cent had over ½ inch but less than 1½ inches, and 35 per cent had 1½ inches or more of shortening (Fig. 1).

It will be apparent that these figures give an abnormally high incidence of shortening. They pertain to patients in the Out Patient Department with sufficient residual crippling to warrant their seeking

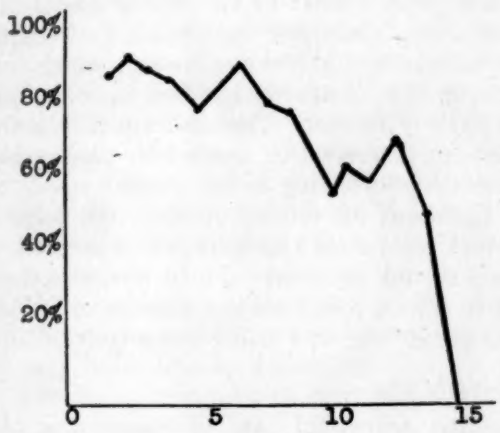

Figure 2. *Percentage of 371 Patients Developing Shortening of ¼ Inch or More.*

medical help. In the poliomyelitis population as a whole the gross incidence of shortening must be considerably lower than the figures from this clinic.

Age at Onset

It will be obvious to the most casual observer that the age at onset must be an important factor in the production of discrepancy in leg length.

Adults who develop poliomyelitis can be expected to develop no discrepancy in leg length. But the infant, upon whom the growth retarding effect of poliomyelitis may act for the rest of his growing years, has a real chance of developing inequality in length (Fig. 2 and 3).

Sex

Inequality in leg length of moderate or marked severity is more frequent in boys than in girls (Fig. 4).

The growing epiphyses of the lower extremities close approximately two years earlier in girls than in boys. Therefore, the retarding effect of poliomyelitis has a shorter time in which to act on the growing epiphyses of the former. Also the average adult leg length is less in the female than in the male, and therefore a percentage retardation of

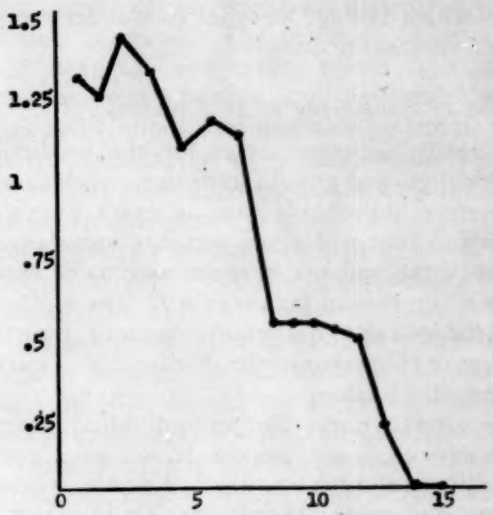

Figure 3. *Average Shortening in Inches among 371 Patients.*

growth should produce less actual discrepancy in length in the female than in the male.

Muscular Weakness

Discrepancy in adult leg length in poliomyelitis is practically invariably associated with asymmetrical

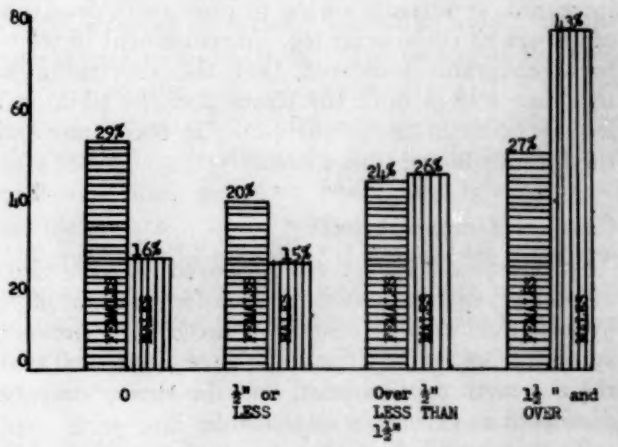

Figure 4. *Shortening of Leg among 191 Female and 180 Male Patients.*

paralysis. In the cases under consideration no significant shortening was found in patients with symmetrical motor power. Whether the legs were totally paralyzed, partially paralyzed or normal, the

legs were essentially equal in length, provided the involvement was bilateral and symmetrical.

The greatest amount of shortening occurred in cases in which there was one essentially normal leg and one totally paralyzed and in which the onset was at an early age. In every case in which there was one normal and one severely paralyzed leg, and in which the age at onset was under ten years, marked shortening occurred.

Amount of Shortening to be Expected

No really accurate tables for the prediction of individual normal growth have been worked out. It is therefore improbable that an exact formula can be devised that will allow accurate long-range prediction of the amount of shortening to be expected in any given case of poliomyelitis. The multiplicity of variable factors affecting normal growth, in addition to those due to the disease, complicates the problem still further.

The growth curve for an individual patient is rarely smooth, since growth is not at a constant rate. Illness and health, use and disuse, winter and summer, and many other factors are involved.

In 1 case (Case 41402), in which poliomyelitis occurred at the age of five, the discrepancy in leg length, as indicated by clinical measurement, appeared to occur throughout the growing period. One leg was essentially normal in muscle power, and the paralyzed leg had about one third normal strength.

Both clinical measurements and teleoroentgenograms in another case (Case 60479) demonstrated that there was some shortening soon after onset; then the growth rate was essentially the same until about the age of thirteen, when the discrepancy increased, apparently owing to premature cessation of growth of the shorter leg. Measurement of teleoroentgenograms indicated that the shortening in this case was in both the femur and the tibia, but it may occur in the femur alone, in the femur and the tibia or in the tibia alone.

Cause of Unequal Growth

At one time a theory was proposed that the virus of poliomyelitis might directly affect one or more hypothetical growth centers in the central nervous system. No satisfactory evidence indicates that these growth centers exist, and the theory may be dismissed as extremely improbable.

The observed fact that unequal growth occurs only when there is unequal paralysis leads to the assumption that the relative amount of use of the two extremities is an important factor.

Another related factor is the circulatory status of the two extremities. Decreased circulation probably causes retardation, and increased circulation stimulation of growth of the involved extremity. Quantitative measurement of the circulatory status of the extremities in poliomyelitis should prove to be a fruitful field for investigation.

Equalization of Leg Length in the Adult

The prevention and correction of discrepancies in leg length in poliomyelitis has engaged the interest of clinicians for many years. The methods of equalization of leg length available for adults are the use of a high sole, lengthening of the shorter limb and shortening of the longer limb. Adult discrepancies of less than ¾ inch may, as a rule, be ignored. Occasionally, backache due to abnormal strain develops in these cases, requiring the use of a heel lift to equalize length.

Adults with moderate shortening (¾ to 1½ inches) usually require some shoe correction, whereas those with over 1½ inches of shortening almost invariably use a high sole to equalize length. The optimal amount of shoe correction depends upon a number of factors, which must be taken into consideration in each case. Complete equalization of length is rarely indicated, for the weaker leg, which is also the shorter one, is usually handled more easily if it is left slightly shorter. The clinician may estimate the amount of correction needed by placing blocks beneath the shorter leg as the patient stands barefoot. Sufficient lift is used to level the pelvis and to correct the list of the spine. The correction on the heel should be about ½ inch less, and the sole lift ¾ to 1 inch less than the amount of lift necessary to correct the shortening completely.

Leg Lengthening

The first successful case of lengthening of the femur was reported in 1905 by Codivilla,[9] and additional cases were subsequently reported by Putti and Landini,[10] Abbott and Crego[11] and Compere.[12] But the operation is rather formidable and carries some risk of disaster from sepsis (osteomyelitis) and from delayed or absent union. The prolonged skeletal traction required is painful and necessitates several months of hospitalization. A full range of knee-joint motion after this operation is rarely obtained, and in a high percentage of cases, knee function is severely and permanently impaired. The operation of femoral lengthening was therefore soon abandoned.

Lower-leg lengthening (tibia and fibula) gradually supplanted femoral lengthening, and during the early 1930's enjoyed a considerable vogue. Abbott,[13] Wilson and Thompson[14] and others have used it successfully, most of the patients being children or young adults. Barr and Ober[15] reported a small series of cases in adults with good results. Lengthening of over 3 inches has been reported, but the average gain in length is 2 inches or less. This operation is subject to the same risks of sepsis and delayed union as femoral lengthening, and although knee-joint function is not appreciably affected, the ankle and foot are usually pulled into a deformed position (equinovarus), which requires operative

revision and stabilization of the foot in most cases. These and other problems make the procedure of leg lengthening one not to be embarked upon lightly. It is safe to say that the operation, once reasonably popular, is now rarely done.

Leg Shortening

Shortening of the longer leg is the surgical alternative to leg lengthening in adults. Femoral shortening has been reported by several authors,[14, 16–18] and a number of variations in surgical technic have been proposed. The operation is not too difficult; the risk of sepsis and nonunion is less than that in leg lengthening, and the joint function is, as a rule, not impaired. The period of hospitalization and of disability is much less for femoral shortening than for leg lengthening. Femoral shortening in most clinics is now the operation of choice for equalization of adult leg length.

Shortening of the tibia and fibula is also a feasible method of equalization of leg length and has been performed in a small number of cases by Ober and by me. It is technically not so difficult as femoral shortening, and a leg cast only is required for postoperative immobilization, whereas femoral shortening requires a spica cast or suspension of the leg on a splint with the patient confined to bed. In 2 of my cases, there was marked postoperative swelling, with impairment of circulation of the foot, apparently owing to kinking of the blood vessels. Lumbar sympathetic novocain block and lumbar ganglionectomy may be of benefit if this complication occurs. The operation may prove to have advantages over femoral shortening.

Many patients and not a few surgeons are averse to major elective surgery on an extremity that is normal or nearly so. Though the procedure of leg shortening does not carry undue risk, it should be undertaken only after careful study of the problem by the surgeon and with the patient fully informed of the risks involved. Both the patient and the surgeon may accept the risk in the reasonable expectation of success. Freedom from a cumbersome, conspicuous, high sole is a goal worth striving for. The operation should be performed only if the weaker, shorter limb will be freed of all apparatus. If the patient must still wear a brace, little relative improvement is to be obtained by elimination of the high sole.

Equalization of Leg Length in the Growing Child

The prevention of length discrepancy in the growing child has engaged the orthopedic surgeon's attention for many years, and today there is great interest in this problem. If a child has asymmetrical muscular weakness, what can be done to prevent or ameliorate the discrepancy in leg length that may be anticipated in such a case?

Nonoperative measures. So far as possible one should promote and maintain equal function in the two legs. Full use of one limb and full immobilization of the other for prolonged periods should be avoided. In particular, prolonged plaster immobilization of the slower-growing extremity is harmful. The slower-growing limb should be dressed warmly and kept from chilling in cold weather, for it is logical to assume that there is an optimal temperature for growth of the epiphyseal plates.

Operative measures. The insertion of ivory pegs into or near the epiphyseal plates to stimulate growth was recommended and performed several decades ago without demonstrable beneficial effect. Similarly, juxtaepiphyseal drilling,[19] more plausible in theory, has proved disappointing on clinical trial and has been abandoned in most clinics.

Sympathectomy to stimulate growth was first proposed by Harris.[20, 21] If the operation is properly performed[22] the skin temperature of the affected limb is demonstrably raised, and the effect appears to be long lasting. In addition to the effect on growth, the cold, blue, lower extremity subject to excessive sweating, chilblains and ulcers is replaced by a warm, pink, dry lower extremity. The exact effect of sympathectomy on growth is difficult to assess in quantitative fashion. In 8 out of 9 cases in which sympathectomy was performed at the Massachusetts General Hospital, in an attempt to stimulate growth, the rate of growth of the affected limb kept pace with or actually exceeded that of the opposite limb. In only 1 of 4 cases has increased shortening occurred after sympathectomy. End-result studies on a larger series of cases are needed before final conclusions can be drawn, but this operation holds promise of being of real value. It is essentially without risk, hospitalization is short, and convalescence is rapid. It cannot be expected to be of much benefit if marked shortening has already occurred or if the operation is done after the age of twelve or thirteen. The young child with marked paralysis of one extremity and a nearly normal opposite extremity is a good candidate for this operation, particularly if the affected limb is cold and blue, perspires freely and is subject to chilblains.

Retardation of growth of the longer leg by operative arrest of growth of one or more epiphyseal plates (epiphyseal arrest, or epiphyseodesis) was first proposed by Phemister.[23] Several authors have reported series of cases in which the operation has been done and have discussed selection of cases, operative technic and end-results.[6, 19, 24, 25] The epiphyseal plates most commonly fused are those near the knee joint — that is, those of the lower femur and the upper tibia and fibula. There is no doubt that the operation effectively retards growth. If the lower femoral epiphyseal plate contributes approximately 40 per cent and the upper tibial 25 per cent of the total leg length, fusion of these

two growth centers should retard further growth of the extremity by 65 per cent. But numerous difficulties arise in connection with this procedure. There is no accurate method of long-range prediction of the final discrepancy in leg length that would occur if no corrective measures were instituted. Until a satisfactory method of growth prediction is evolved, the age at which epiphyseal arrest should be done cannot be accurately estimated. White and Warner,[25] Gill and Abbott,[6] Straub, Thompson and Wilson[24] and Green and Anderson[4] have worked out methods of predicting the retarding effect of epiphyseal arrest on growth. The method of Green and Anderson has the virtue of simplicity, since the amount of retardation of growth to be obtained by epiphyseal arrest at any given skeletal age may be read directly from a chart. The operative technic of epiphyseal arrest consists in excising medial and lateral portions of the epiphyseal plate and replacing them with bone blocks, which extend into both the epiphysis and the diaphysis. An operative procedure that the authors consider satisfactory is described in detail. Not all surgeons have found the operation either easy to perform or uniformly successful in outcome. Deformities of the knee (valgus, varus and recurvatum) were noted in 6.5 per cent of cases reported by Green and Anderson[4] and in 11 per cent of those reported by Wilson and Thompson[14] and Regan and Chatterton.[26] Almost 10 per cent of the series of Green and Wilson required secondary operation because of deformity or lack of effective fusion of the epiphyseal plate or for arrest of the opposite side because of overcorrection.

Nevertheless, epiphyseal arrest is a method of proved success. It can be expected to equalize discrepancies in length of considerable magnitude. Careful consideration must be given to proper case selection. The correct age for operation and the epiphyses to be fused must be carefully determined. The operation must be meticulously performed. Attention to these factors will ensure that approximately 90 per cent of the patients will reach adult life with shortening of no clinical significance.

Irradiation to retard longitudinal growth. For a number of years Barr and his associates[27, 28] at the Massachusetts General Hospital have carried on experimental work on animals as a preliminary to the clinical use of irradiation. This work indicates conclusively that x-ray irradiation of the growing epiphyseal plates of the rat and the dog produces definite retardation in longitudinal growth. Single doses of 800 to 1200 r were effective, and the retardation was roughly proportional to the dosage employed. The maximal retardation in growth of an individual epiphysis was about 80 per cent, but the retarding effect was lessened by an overgrowth of adjacent, untreated epiphyses. The net maximal retarding effect on growth of an individual bone by treatment of one epiphysis was about 30 per cent. Histologic examination revealed no evidence of damage to skin, subcutaneous tissues, muscle and bone. The articular cartilage, though normal to gross examination, showed mild but definite microscopical changes indicative of cellular damage. The clinical use of x-ray irradiation to prevent shortening or to equalize discrepancies in length already acquired must be considered to be in the experimental stage. It holds definite promise, however, and may prove to be a useful and effective method.

Summary

Normal growth is influenced by many hereditary and environmental factors, which determine the size and shape of limbs. It is extraordinary that symmetrical limbs of equal length are the rule and not the exception.

The causes of unequal growth of the legs, resulting in shortening, are discussed, with particular attention to poliomyelitis.

The exact incidence of leg shortening due to poliomyelitis is not known, but approximately a third of the patients with poliomyelitis treated in the Out-Patient Department of the Massachusetts General Hospital with onset before the age of sixteen developed marked inequality in leg length. The factors of importance in determining whether a patient will develop discrepancy in leg length include age at onset, sex and the amount and distribution of muscular weakness of the legs. There will be no shortening if the involvement is symmetrical. The greatest shortening occurs in young patients with one normal and one severely paralyzed limb.

Inspection of growth curves of individual cases suggests that the growth retardation is not constant. The maximum retarding effect appears in some cases to occur late in the growing period. Premature cessation of growth associated with epiphyseal closure on the paralyzed side may explain late occurrence of severe discrepancies. Exact prediction of the amount of shortening to be expected in a given case is not yet possible. The possible causes of unequal growth in poliomyelitis include changes in circulation and disuse of the extremity.

Operative correction of adult discrepancy in length is possible by leg-lengthening or leg-shortening procedures; the latter appear to be preferable.

In the growing child epiphyseal arrest offers a method of equalization that in properly selected cases is very effective. Careful attention must be given to the proper age for intervention and to the operative technic.

Sympathectomy as a procedure to maintain equality in leg length is still *sub judice*, but it appears to be of value if done early enough.

Every growing child with poliomyelitis should be under the regular supervision of an orthopedic surgeon who is thoroughly familiar with the problem of unequal growth. Regular measurement of the

leg length, clinically and by x-ray examination, will allow early detection of shortening. The surgeon by suitable selection of operative methods and by promotion of normal function in the affected extremity will be able to prevent much of the shortening that would otherwise occur. The unsightly cork or wooden high sole should become a much less familiar sight. Eventually the time may come when no child will need to face adult life with that handicap.

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

TRACY B. MALLORY, M.D., *Editor*

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CASE 34211

Presentation of Case

A fifty-six-year-old engineer was admitted to the hospital because of pain in the right side and difficulty in breathing.

Approximately six months before admission the patient developed a cough productive of "white mucus," but had no other symptoms. Seven weeks before admission he awoke one morning with a severe pain in the right lower chest, which was made worse by breathing. Records from the hospital in which he was treated stated that there were physical and x-ray findings of a pulmonary infarct. He was given penicillin and dicumarol. During the hospital stay he became violent and developed delusions of persecution. After three weeks of hospitalization he was discharged but was never free of chest pain. Later, this became worse and was aggravated by breathing. Two days before entrance to this hospital an x-ray film taken at another hospital was reported as showing "a large abscess cavity in the right subdiaphragmatic region and a right-sided pleuritis." He lost approximately 35 pounds in the course of the illness.

The patient had had a "double coronary" seventeen months before admission. He had had occasional ankle edema and slight exertional dyspnea since then.

Physical examination revealed a man with somewhat grandiose ideas and with some difficulty in thinking of words. The chest was emphysematous with expansion limited by pain. There was dullness over the lower third of the right chest posteriorly. The right leaf of the diaphragm was elevated and limited in excursion. Breath sounds and vocal fremitus were diminished over the right lower chest. A friction rub was audible posteriorly near the right base. The liver edge was palpable three fingerbreadths below the costal margin and was tender.

The temperature was 99°F., the pulse 120, and the blood pressure 110 systolic, 80 diastolic.

Examination of the blood disclosed a hemoglobin of 12.2 gm. and a white-cell count of 16,700, with 89 per cent neutrophils. The urinary sediment contained a rare white cell. The sputum was negative for acid-fast organisms.

An x-ray film showed questionable fluid over the lower half of the right chest. The middle lobe was collapsed. There was a fluid level with an air space above it at the right base. The right leaf of the diaphragm could not be identified, since it did not move with respiration. The left lung field was clear. An electrocardiogram showed low voltages and probable right-axis deviation. In addition, in the chest leads the S waves were prominent, and the R waves small to absent.

The patient was prepared for a thoracotomy on the second hospital day. Quinidine (0.15 gm.) was given one hour before operation. A short time after the intratracheal tube had been inserted the patient stopped breathing, and no pulse could be obtained. Attempts at resuscitation were unsuccessful.

Differential Diagnosis

Dr. F. Dennette Adams: One must consider the entire gamut of subacute and chronic pulmonary diseases: tuberculosis, abscess, bronchiectasis, foreign body, actinomycosis and others. However, the evidence in this case seems typical, if one can say anything in medicine is typical, of bronchiogenic carcinoma. The illness started with cough, virtually nonproductive, for four weeks. There were no other symptoms except quite rapid loss of weight. Then an acute episode occurred — fever and pain in the chest. The record from the other hospital states that the patient had typical signs and x-ray findings of pulmonary infarction. One hesitates to be critical, and yet it should be pointed out that this is a broad statement.

Pulmonary embolism presupposes thrombophlebitis or phlebothrombosis. If the patient was up and around, phlebothrombosis would not be likely; if he had thrombophlebitis, he would have in all likelihood signs in his legs. So there is very little ground for presupposing trouble in the veins unless one wishes to assume that it was there because of the presence of a malignant lesion elsewhere. In my opinion, one cannot say that either the physical or x-ray signs were necessarily typical of pulmonary infarction. Similar signs may occur in collapse and in pneumonia. Furthermore, when the signs appear with pulmonary embolus in the lungs they have to be due to a fairly large embolus, and in such a case one would expect at the onset some signs of temporary insult to the circulation. This patient apparently had no such episode. I am much more inclined to believe that the trouble was infection: pneumonia or, if my original assumption is correct, more probably secondary infection behind complete obstruction of a bronchus. Another good reason for believing that this was not a pulmonary infarction is the fact that the pain continued; the patient with pulmonary infarction recovers rapidly unless more emboli form.

This man continued to be sick, to have pain and to lose weight. He came into the hospital with grandiose ideas and difficulty in thinking of words. We shall come back to this in a moment. The signs in the chest on admission to this hospital could have been due to almost any form of pulmonary disease: low-grade infection, thickened pleura, fibrosis or collapse or a combination of these. The statement that the right leaf of the diaphragm was elevated cannot be made if other recorded physical signs were correct. With dullness and diminished respiratory sounds the diaphragmatic movements could not be determined accurately. The patient still had a friction rub. We can assume that he had it all along because of the pleural type of pain. The white-cell count indicated a suppurative form of infection, and this was borne out by the x-ray film, which showed a pulmonary abscess. This could be secondary to pneumonia, bronchial obstruction from foreign body, tumor or other cause or to infarct.

My belief is that in a man of fifty-six with this history and the disease taking the course described, one is justified in making almost a flat-footed diagnosis of bronchiogenic carcinoma with obstruction and secondary infection.

Will Dr. Wyman demonstrate and discuss the films for me?

Dr. Stanley M. Wyman: There seems to be definite fluid along the lateral margin of the right chest. The right leaf of the diaphragm cannot be identified laterally, but there is a suggestion of the diaphragm medially, and a large cavity containing air and fluid. A definite fluid level is seen in the midlower portion of the lower lung field, which lies posteriorly in the lateral view. The right lower lobe appears to be diffusely consolidated and perhaps slightly decreased in size. I cannot identify the collapse of the middle lobe described.

Dr. Adams: Is the lung pulled over a little?

Dr. Wyman: It does not seem so to me. The chest is rotated slightly. The spine in its midportion lies here to the left so that this appearance might be due to the rotation of the patient on the film. I can identify the left main bronchus fairly well. The right main bronchus I can follow only down to about 3 cm. beyond the bifurcation. I cannot make out a definite mass, but there is a suggestion of some hazy density overlying this portion of the hilus, with a poorly defined lateral border.

Dr. Adams: I am still going to stick to the diagnosis already made. The best bet in a man of fifty-six years, who has cough for several months, then develops an abscess and meanwhile loses weight and goes downhill, is a malignant lesion of a bronchus, with obstruction and secondary infection.

As I read over this record, I wondered about the haste in operating. The patient came in one day and was prepared for operation on the next. He was not bronchoscoped. Little attention seems to have been paid to what appears to have been a significant factor: when the man was in another hospital several weeks previously he was paranoid, and while in this hospital he had obvious personality changes. The degree of fever is hardly sufficient to account for so much personality change. No studies were done to try to determine its cause. One cannot exclude a psychosis unrelated to the rest of the picture, and yet that seems no more than tenable. The patient could have had general paresis, but we have no evidence at all. He could have had — and this merits particular emphasis — a drug psychosis, a disturbance often overlooked because not thought of. He had pain for a long time. We do not know what medication he was getting. He may have been filling himself up with bromides or barbiturates. I have recently seen 2 cases of bromide poisoning resembling this picture. The other possibility, and the one that seems to me most likely, is a metastatic lesion in the head, either carcinoma or abscess. One cannot distinguish between the two, but on general principles, if my basic diagnosis is correct, metastatic cancer seems more likely than abscess.

What was the cause of death? The patient was known to have had a coronary infarction. The electrocardiogram showed low voltage, suggesting a poor myocardium or, less likely, pericardial disease, perhaps spread of the tumor into the pericardium. The changes in the R and S waves suggest the possibility of residua of old coronary-artery disease. One cannot state that the sudden death was not due to heart failure. Certainly, the small dose of quinidine cannot be held responsible. On the other hand, we must remember that the patient had been subjected to some manipulation while the intratracheal tube was being inserted, and I think that he may have died of a pressure cone although this is really not much more than a guess. Since a diagnosis must be ventured, I am going to commit myself to carcinoma of the bronchus with secondary infection of the lung due to bronchial obstruction, metastatic carcinoma of the brain and death from a pressure cone.

Dr. Donald S. King: Are you sure that the process is not below the diaphragm, Dr. Wyman?

Dr. Wyman: No; I am not sure by any means. I think that I can outline the right leaf of the diaphragm medially and also in the lateral view anteriorly. I cannot be sure but I think that it is above the diaphragm.

Dr. John Quinby: Do you think that there is some emphysema on the left?

Dr. Wyman: The films are overexposed to bring out the details in the right lung, making accurate statement about the left lung difficult. However, there is some emphysema on the right side.

Dr. Adams: That could be explained on the basis of compensation.

Dr. Wyman: Yes; there is a little compensatory emphysema in the upper lobe on the right side.

Dr. Adams: The patient had an overdistended lung base. We know that he used that lung more for the air that he needed.

Dr. Wyman: It is not a process of long standing, however; and the anteroposterior diameter of the chest is not significantly increased.

Dr. Carroll C. Miller: I saw this patient in another hospital before he was admitted to the Baker Memorial. At first sight he was a very sick man and obviously not getting better. The local physician and I could not make a definite diagnosis. X-ray films taken in the other hospital were perhaps more equivocal than ours are in determining the location of the diaphragm, and we did not know whether the abscess cavity, this air-filled pocket with fluid in it, was below or above the diaphragm. The patient was mildly confused in his thought processes, and it was difficult to get a clear-cut, consecutive story from him. The history showed no evidence of drug toxicity. He had been followed for several months in a hospital in the Midwest and later at this local hospital. It was thought that drugs did not enter into the picture. He had had a definite change of personality and at one time had threatened his wife.

Dr. Adams: Are you sure that was not routine?

Dr. Miller: That was a definite change. I had him admitted to the Baker Memorial, and because of improvement in his mental status at the time, this did not seem to be a problem. Because of the fact that he was running a spiking temperature Dr. Richard H. Sweet decided to drain the area as soon as possible. We had entertained the possibility that the process was a subdiaphragmatic abscess, and it was rather difficult to make sure that he had not had a ruptured ulcer because he had had vague upper abdominal fullness within the past year. That added to the confusion in trying to determine whether the lesion was above or below the diaphragm. The physical findings on admission here were the same as those at the other hospital — diminished breath sounds with rales at the right base.

In reference to your remark about confinement to bed, he was immobilized for a considerable period in a hospital in the Midwest during the episode of coronary-artery disease.

Dr. Adams: That had been eighteen months before, however.

Dr. Miller: Yes; a long time before. The possibility of infarcts with subsequent breakdown and abscess formation within the lung occurred to all of us. The picture did not appear like a clear-cut lung abscess to us. There was no foul-smelling sputum during the course of the disease, and the cough seemed not to be a major problem. It was not

the typical cough that accompanies carcinoma of the bronchus, which is more commonly an irritative one. Of course we had had in the back of our minds carcinoma of the lung; not infrequently we see such cases without typical symptoms.

A word about the anesthesia: it was entirely uneventful. During the induction of anesthesia the patient was quite dry, and there was no appreciable amount of struggling. He simply stopped breathing just as he was to be taken into the operating room and could not be revived.

Clinical Diagnoses

Coronary occlusion.
Subdiaphragmatic abscess?

Dr. Adams's Diagnoses

Bronchiogenic carcinoma, with metastasis to brain.
Secondary lung abscess.
Pressure cone.

Anatomical Diagnoses

Empyema, right pleural cavity.
Coronary sclerosis, with occlusion.
Infarct of heart.
Emphysema, moderate.

Pathological Discussion

Dr. Tracy B. Mallory: Autopsy showed that the cavity was above the diaphragm and was entirely within the pleural cavity, a large encapsulated empyema. We were not able to identify any intrapulmonary lung abscess. There remained the possibility, of course, that there had been a small intrapulmonary abscess that had ruptured into the pleura and had been the source of the empyema. The old coronary-artery disease was sufficient to have caused complete occlusion of the descending branches of the left coronary artery and a very large area of infarction at the apex of the left ventricle, running halfway up the interventricular septum. This was covered by a thick partially organized thrombus. There was no evidence of cancer, and no lesion could be found in the brain—abscess, infarct or tumor.

Dr. Adams: Why did the patient die?

Dr. Mallory: I cannot explain the mechanism. He had the type of heart with which a patient could die instantly.

CASE 34212

Presentation of Case

A fifty-three-year-old hospital employee was admitted to the hospital complaining of nausea, vomiting and diarrhea.

His employment at the hospital began two months before admission. A routine examination was negative. The heart and lungs were within normal limits on physical and x-ray examination. The blood pressure was 140 systolic, 88 diastolic. A routine urine examination demonstrated an acid urine, with a specific gravity of 1.018 and the absence of sugar and albumin. A microscopical examination of the urinary sediment was not done. Two weeks before admission the patient began to feel "logy," vaguely sore between the shoulder blades and chilly (without frank chills). On the next day he lost his appetite and noticed that his throat was sore. He became nauseated, vomited all food and liquids ingested, including water, and began to have watery bowel movements, up to four or five a day. These complaints continued up to admission. One week before admission dyspnea on climbing one flight of stairs appeared. He had never had any dyspnea previously. There was no orthopnea. He had a slight tickling cough, productive of small amounts of whitish sputum. A week before admission he blew a clot of blood from his nose, but he insisted that he had not actually coughed up any blood. On the day before admission the nasopharynx was injected; general physical examination was otherwise not remarkable, and he was afebrile. A chest film demonstrated cardiac enlargement, with pulmonary congestion and a small right pleural effusion (Fig. 1).

The only previous illness he could recall was an attack of "asthma" about six years before entry, which subsided without treatment.

Physical examination revealed that the patient was not acutely ill, but was somewhat pale; the tongue was dry, and the throat was beefy and a little edematous. The superficial veins of the neck were distended 1 or 2 cm. above the clavicles in the semierect position. A few, moist, inspiratory rales were present at both lung bases, and there was some dullness over the right base. The heart was slightly enlarged to percussion. No murmurs were present. The sounds were distant and of poor quality, but no gallop rhythm was heard. The liver

edge was percussed 3 cm. below the right costal margin. There was slight tenderness to percussion in both costovertebral angles, more on the right than on the left. The prostate was very slightly enlarged. There was slight pitting edema over the ankles. No calf tenderness was present.

The blood pressure was 185 systolic, 95 diastolic.

Examination of the blood disclosed a red-cell count of 3,200,000, with a hemoglobin of 11 gm. per 100 cc., and a white-cell count of 9900, with 86 per cent neutrophils. The specific gravity of the urine varied between 1.015 and 1.022, and there was a +++ test for albumin. Repeated examinations of the urinary sediment demonstrated between 5 and 15 red cells and between 20 and 50 white cells per high-power field. Many hyaline, granular and red-cell casts were found. The fasting blood sugar was 113 mg., the nonprotein nitrogen 100 mg., and the total protein 6.6 gm. per 100 cc. The carbon dioxide was 17.7 milliequiv., and the chloride 104 milliequiv. per liter.

Three hours after admission to the Emergency Ward and thirty minutes after arriving on the hospital ward the clinical condition changed dramatically, and severe, acute, pulmonary edema appeared. Therapy included morphine, oxygen by mask, intravenous cedilanid and aminophyllin. An initial response to this treatment was favorable, but a picture of pulmonary edema continued. On the second hospital day there was distinct mental confusion, with mumbling and lapses of memory. On the next day the nonprotein nitrogen was 125 mg., the calcium 8.2 mg., and the phosphorus 7.5 mg. per 100 cc. The chloride was 110 milliequiv., and the carbon dioxide 18.9 milliequiv. per liter. The patient died that day.

Differential Diagnosis

Dr. Briant L. Decker: May we see the x-ray films? Have you the old films?

Dr. Stanley M. Wyman: No; they are not available. In this recent series of films the heart shadow cannot be adequately outlined, but it seems to extend farther to the right and left than is normal. The heart, although it cannot be well seen, is probably enlarged. There is a definite pleural effusion on the right obscuring the costophrenic angle. The diaphragm is elevated, with localized effusion in the minor septum between the right upper and the middle lobes. There is probably some fluid on the left, although that cannot be stated with certainty. The pulmonary vascular shadows of both hili are definitely increased. This increased prominence extends fairly well out into both lung fields peripherally. One cannot see any definite intrinsic localized pulmonary disease. There is nothing specific that one can say about the configuration of the heart.

Figure 1.

Dr. Decker: Do you believe that the hili are consistent with congestive failure?

Dr. Wyman: Entirely consistent with congested arteries, but the possibility of nodes in one or both hili cannot be excluded. This might be determined by fluoroscopy; one cannot exclude nodes from the films alone.

Dr. Decker: In summary, we have the history of a fifty-three-year-old man whose only known previous illness was an attack of asthma six years before admission, the details of which are not given. He was in apparently good health until two months before admission except for the possibility of slight hypertension. For two weeks before admission he had symptoms of acute infection localized in the pharynx, but he also had gastrointestinal symptoms. One week after the onset of this infection he de-

veloped symptoms of congestive failure, and on admission to the hospital, examination showed acute pharyngitis, fairly marked hypertension and signs of both right-sided and left-sided cardiac failure. Laboratory tests revealed a slight normochromic anemia, a high normal white-cell count, with a fairly marked neutrophilic reaction, a urine typical of, or rather consistent with, acute glomerulonephritis and blood chemical findings indicating a nonprotein nitrogen retention and moderate acidosis. Although the patient did not appear very ill on admission, he shortly afterward developed severe acute pulmonary edema, which responded poorly to treatment. Within twenty-four hours he developed mental confusion and within forty-eight hours died, I believe of congestive failure.

Of the possible explanations of the history the first condition that comes to mind is acute glomerulonephritis. The patient was older than is usual with that condition, but there have been at least 2 cases of acute glomerulonephritis in elderly patients reported here in the past year. I must assume that the onset of the nephritis was coincident with or very shortly followed the acute throat infection. This is not very usual. It is possible and even probable that the onset of the initial infection that caused the acute glomerulonephritis was unnoticed, and that the symptoms that were evident two weeks before admission — nausea and vomiting, particularly — indicated the onset of renal failure and nitrogen retention. It is not usual for a patient with acute glomerulonephritis to go into uremia as quickly as this patient apparently did, but in a small percentage of these cases that happens. More often the patient develops hypertensive encephalopathy, with marked cerebral symptoms and convulsions. These symptoms are not dependent on a high nonprotein nitrogen. In this case, however, the nonprotein nitrogen was considerably elevated and rising, and there was a low serum calcium, an elevated phosphorus and a decreased carbon dioxide — all characteristic of uremia. The cerebral symptoms were only moderate, and there were no convulsions.

An acute flare-up of chronic pyelonephritis or an initial onset of acute pyelonephritis seems unlikely to me because of the absence of typical symptoms — chills, a febrile course and so forth — of characteristic urinary findings. I believe that the finding of casts, particularly the red-cell casts, is against pyelonephritis. For similar reasons bacteremia with an acute focal nephritis does not seem tenable. However, another condition that might well explain the whole picture is periarteritis nodosa. This usually affects younger persons but may occur at any age. It is usually of weeks' duration, runs a febrile course and is almost invariably associated with, or follows, an acute infectious process. The febrile course was not evident in the case under consideration, but the period of observation was brief. Renal lesions are present in a high percentage of these cases, — about 80 per cent, — and frequently these are suggestive of acute glomerulonephritis, with accompanying renal failure. Cardiac involvement is likewise very frequent. The symptoms of periarteritis nodosa may be so varied that it is a very convenient condition to mention in these discussions. It is rather difficult for me to decide between these two conditions, but on the basis of probabilities it is my opinion that this man had acute glomerulonephritis. It may have been associated with periarteritis nodosa, but that is my second choice. I believe that he died of congestive failure and had uremia.

Dr. Lincoln Clark: I can add a few details. During the last day the patient developed a paranoid psychosis. He believed that we were trying to poison him, refused medication and became belligerent and combative. I examined him but could find no change from the previous day. The nurse called me because he had refused to take penicillin. He was wildly thrashing around and snatched the stethoscope from me. Five minutes later he was dead. The examination of the chest, so far as it could be accomplished, revealed the clinical findings of pulmonary edema with markedly diminished respiratory exchange. The psychotic episode was probably the preliminary phase to the pulmonary edema of which he died.

Dr. Tracy B. Mallory: Does no one want to suggest a lower-nephron nephrosis? Patients with that condition commonly die of acute pulmonary edema, and it is statistically becoming more frequent than glomerulonephritis. There are two points in the history that are strongly against it. One is the specific gravity of 1.022, which would be very much higher than one would expect; the other is the red-cell casts.

Dr. Wyman: From the x-ray point of view pulmonary edema, vascular congestion and pleural

effusion are all present. This may be associated with nephritis and might be the result of it. One would have to suppose that the patient had pre-existing or co-existing heart disease because of the degree of cardiac enlargement.

Dr. Mallory: That film was taken the day before the clinical evidence of pulmonary edema developed.

Dr. Wyman: Yes; he already had x-ray evidence of edema at that time.

Dr. Decker: I considered the possibility that the attack of asthma six years previously was really an attack of acute pulmonary edema, indicating a damaged heart then, and that this superimposed elevation of blood pressure, uremia and so forth, was enough to produce this picture. That is one reason why I wanted to see the old x-ray films to determine if at that time the heart was borderline in size.

Clinical Diagnoses

Acute pulmonary edema.
Uremia due to nephritis,
unknown cause, and to
cardiac insufficiency of two weeks' duration.

Dr. Decker's Diagnoses

Acute glomerulonephritis.
Uremia.
Congestive failure.

Anatomical Diagnoses

Acute glomerulonephritis.
Chronic vascular nephritis, slight.
Acute pulmonary edema.
Hypertrophy and dilatation of the heart, hypertensive type.
Hydrothorax, bilateral.

Pathological Discussion

Dr. Mallory: At autopsy we found enlargement of the heart and the kidneys. The heart weighed 460 gm. The coronary arteries were in very good condition, and there were no valvular lesions so that we are forced to assume that there had been a hypertensive heart disease of considerable standing.

The kidneys were very much enlarged; they weighed 500 gm. The capsule stripped with difficulty, leaving a pitted surface that suggested underlying renal disease of long standing, but the microscopical sections showed an extremely acute glomerulonephritis. I think it was superimposed on a slight chronic vascular lesion, which probably had been present for many years. The fresh episode is very characteristic of acute glomerulonephritis, and could not possibly be confused with the so-called "malignant phase" of vascular nephritis. The fatal episode of acute pulmonary edema is not the usual mode of exit for these cases with a non-protein nitrogen still as low as 120 mg. per 100 cc. We saw death from pulmonary edema very frequently in crush and shock kidneys during the war, but in most of those cases the picture was complicated by a great deal of parenteral fluid, which was not given to this man. Consequently, the pulmonary edema in this case was not brought on by treatment. I am inclined to attribute it to acute heart failure rather than to renal failure.

Dr. Alfred Kranes: What was the urinary output during observation?

Dr. Mallory: The patient was in the hospital for such a short time that it is not known.

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"A PATTERN FOR CHILD HEALTH"

THE country-wide study of child-health services, launched in March, 1946, by the American Academy of Pediatrics at the successful conclusion of the pilot study in North Carolina, has been finished. Detailed state by state reports and recommendations are being prepared; the national report will be issued this summer.

The findings of this million-dollar study, financed by the Academy, the federal Government, various foundations, business firms and state organizations were entirely predictable although never before specifically stated. Adequate pediatric care, according to the preliminary reports, does not reach the people, effectively distributed. Isolation from the potential benefits of good medical practice prevails for individuals, for families, for communities and for economic levels of society, the result of geographic and economic factors and of ignorance.

Erratic failures to balance supply and demand persist. There are not enough doctors in practice where doctors are most needed, and too many flock to those communities or sections where better facilities for practice may exist, or where the economic level of the population is higher. In some communities the doctors are available but hospital beds are lacking; in others the beds are available but the doctors are absent. It may be said that in general the pediatric training of physicians is inadequate. Unavailable medical care in the country and failure to utilize available medical care in the city are still responsible for many child deaths. In various aspects relating to health promotion we have even fallen behind some of our progressive neighbors such as Canada and the Scandinavian countries.

Once a diagnosis has been established and accepted the way is open for any possible therapy to be applied, and in this instance the disease is definitely curable. A network of medical services must be developed to cover every community, with hospitals, clinics, health services and physicians. The services of the metropolitan centers must be made to flow out to the rural hospitals. The training of young physicians must be improved to the point that all those in general practice, as well as the pediatricians themselves, will be equipped to give good child care.

The American Academy of Pediatrics has done a splendid piece of work in carrying through this ambitious program of fact-finding. Its business and that of all associated agencies will now be to work toward the proper application of the obvious remedies.

FOUR HUNDRED AND THIRTY YEARS AGO

WE ARE so frequently impressed by the recent advances in scientific medicine, so pleased that we can rightly speak of milligrams and correctly determine the hemoglobin to a fraction of a percent — by machine let it be said — that we are prone to forget that our forebears, without so much as a

Klet or Technicon, laid the firm, substantial foundations on which we build today. Lakin's* Harveian Oration of 1947 recalls our debt to mind.

Our own Association of American Physicians, of which we are justly proud, was founded in 1886 by such men as "Popsy" Welch and Dr. Councilman, known to all as "Councy." Such men as these, the founders and benefactors of our Association, have rightly earned the admiration and respect that is their due.

The British counterpart of this society, its father and mother so to speak, was the Royal College of Physicians founded nearly four hundred years earlier — in 1518 to be exact.

"In the year 1345 King Edward the third had allowed a pension of sixpence a day to Coursus de Gangland, an apothecary of London, for his attendance during his illness." Yet during the fourteenth and fifteenth centuries medical knowledge was at a very low ebb, and "The Peterhouse chained library of 1418 held but thirteen volumes of medicine," among which was the notable work of "Richard of Wendover (ob. 1252), canon of St. Paul's, the compiler of an encyclopedic treatice covering the entire field of medicine": "The one fellow of Cambridge allowed by statute to adopt the medical art was pursuing in 1418 the regular university course; he had borrowed Macer, *De Virtutibus herbarum* and the prescribed texts of Johannicius and of Isaac." When we recall that Johannicius was none other than Honein ibn Ishaq el 'Ibadi, that he died in the year of our Lord 873, and that "Isaac fuit araabs nacione" we realize that medicine then was surely in a sorry state.

Yet only one hundred years later, during the reign of Henry the Eighth — he of the elastic conscience — there was founded the Royal College of Physicians by Thomas Linacre, the Greek and Latin scholar who is said to have introduced the damask rose into England not long before he died in 1525.

There is no direct, unbroken line by which we may connect the medical practice of the ancients with that of the modern day. But it seems certain that during the Dark Ages Arabic medicine was supreme and that the most important results of the revival of learning in the fifteenth and sixteenth centuries were the accurate translations from Greek into Latin of the great masters such as Hippocrates and Galen. Among the very foremost of these translators was Thomas Linacre, founder and benefactor of the Royal College. The revival of Hippocratic and Galenic medicine did not immediately produce any important reform in practical medicine, but the great outbreak in England of the "sweating sickness," described so well by John Kaye or Caius, a successor of Linacre, and the appearance of syphilis, seemingly unknown to the Greeks, made it clear that the works of Galen did not contain all that could be known of medicine. Thus were physicians of that day urged on to make their own observations and to a keener attention to the natural history of disease. As early as 1649 the hitherto undescribed rickets was carefully studied by Arnold de Boot, a practitioner in Ireland. From this point it is but a short step to Thomas Sydenham and thence to the great systemizers of medicine — Cullen and Brown. Medical knowledge seemed to wane at the end of that century but received new life from Auenbrugger and Laennec and from that time on with such minor alarums and excursions as the expressed belief of Hahnemann (1753–1844) that "Seven-eighths of all chronic diseases are produced by the itch driven inwards," progress in medicine has been steady until, today, we can speak of millimoles and the MCHC — whatever that may be.

Yet when all is said let us not forget the founders and benefactors of the Royal College, for they and their peers started us on our journey into the Golden Age of medicine from the Dark Ages when doctors were but pompous charlatans and when: "If a poor man speke a word he shal be foul afrounted."

*Lakin, C. E. Our founders and benefactors. *Brit. M. J.* 1:185-188, 1948.

HYGEIA VERSUS PANACEA

As a reminder that the rehabilitation clinic is not a new idea, Miss Hazel Newton, general manager of The Community Workshops, has written a comprehensive letter that is published elsewhere in this issue of the *Journal*. War, with its hideous casualty lists, has swelled the ranks of the handicapped to a point where publicity is being focussed on their needs; the Community Workshops, in a very unassuming way, has been operating in the field of rehabilitation for over seventy years.

Beginning with the extension of aid to persons restricted to their homes because of disabilities or for other reasons, The Community Workshops established a "sheltered shop" in 1915 for seriously handicapped persons, and a "vocational shop" in 1922. In the latter a correlation of the patient's aptitudes and remaining capabilities is attempted. A social-service department was added in 1917.

Increased facilities for reconstruction of shattered bodies and rehabilitation of broken lives are necessary; let us not think that there is anything new in the basic principles involved or in an attempt at their solution.

We shall always have present with us diseases to be treated and incapacities requiring care and efforts at rehabilitation. It is increasingly necessary to reduce them to the minimum by every means that we have in our power.

This side of the shield has been ably presented by Emerson* in his description of the work of a physical-fitness clinic. Here the detailed points that go to make up positive health are described, and the means are listed by which they can be attained if the individual obstacles are not too great. A belief that most of the diseases responsible for untimely death can be prevented from becoming serious if discovered early may still be born in wishful thinking, but in such an admission no argument exists against the cult of salubrious living.

One of the chief obstacles to health work, as Emerson has stated, is the common belief that the absence of disease necessarily implies the presence of health. It is this attitude that has prevented the physician from giving to Hygeia the same serious devotion that he has accorded to her sister, Panacea.

COME ONE, COME ALL!

THE Annual Meeting, regarding which we have been thoroughly and favorably conditioned, is upon us. The booths are set up, the exhibits are ready, the scientific papers are prepared and the section luncheons have been ordered. The circus (in a genteel way) has come to town, and the Big Top is ready for the crowds.

This is the occasion, nicely scheduled for midspring in New England, when we dust off the alpaca and shine our shoes, wash the buggy and curry Topsy and jog into town. It is our chance to meet old friends and hear new things and see the sights. It is our intellectual sulfur and molasses; the year's first mess of dandelion greens!

*Emerson, W. R. P. Work of physical-fitness clinic. *New Eng. J. Med.* 238:249-253, 1948.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

APPROVAL OF CANCER-DETECTION CENTER AT PALMER MEMORIAL HOSPITAL

An application for a cancer-detection center at the Palmer Memorial Hospital was approved by the United States Public Health Service, subject to a new application form, which would go into more detail regarding this clinic. This form was prepared, and a summary of the project follows:

> The proposed cancer-control project entitled "Cancer-Detection Center" is a joint project of the Harvard School of Public Health, the Massachusetts Department of Public Health and the Palmer Memorial Hospital. This center is planned to determine procedures of special value in detecting cancer that may be applied by the physician in private practice, and to serve as a demonstration center for such procedures. This center will aim to determine whether such centers should be a part of all cancer-control programs and to determine whether the physical examination can be divided between the doctor's office and the detection center, with the center furnishing supplementary diagnostic procedures that cannot be supplied by the practicing physician. It will enable evaluation of methods of diagnosis most applicable to the detection of cancer in the physician's office and will enable instruction of physicians concerning these technics.
>
> The project also will include the development of a record system and statistical studies on the data obtained in the center.

PROGRESS REPORT, DIVISION OF HOSPITAL SURVEY AND CONSTRUCTION

Since the Surgeon General of the United States Public Health Service approved the Massachusetts State Plan on December 8, 1947, considerable progress has been made in the program relating to Public Law 725 (the Hospital Survey and Construction Act). Two projects, in Needham and Athol, have received preliminary approval of the United States Public Health Service, and the former in addition is ready to go out on bids.

Because in keeping with the law urban areas in Massachusetts received low priorities for general hospital beds, tentative approval has been given by the Advisory Council to a plan placing these urban areas high in the priority scheme for chronic-disease beds. The amount of funds allotted to the six urban areas, Pittsfield, Springfield, Worcester, Boston, North Shore and South Shore, under this tentative plan is dependent on the population of the area and the need for beds. It is expected that about $2,500,000 of federal funds will be spent in the construction of chronic-disease projects in Massachusetts during the five-year program.

In addition to the above, plans are being made for a complete revision of the existing state plan. Because of such factors as fire hazard, obsolescence and patient-distribution data, the revised state plan will show changes in many areas that may alter materially the priority schedule.

CORRESPONDENCE

THE COMMUNITY WORKSHOPS

To the Editor: The recent emphasis placed upon the processes of restoring handicapped persons to their greatest possible usefulness by the armed forces, the Veterans Administration, the Baruch Committee and certain groups in the medical profession prompts me to submit a brief account of The Community Workshops, an organization that has been engaged in these activities in Boston since 1877.

This organization began with the extension of aid to persons restricted to their homes because of disabilities or special family responsibilities. In 1915, a department known as the "sheltered shop" was added, which has given work and a small wage to persons whose handicaps are so serious that their chances for competitve employment are definitely limited. The persons in this group are saved from unhappy dependency on their families and the community.

In 1917, a social service staff began to participate, and in 1922 a "vocational shop," in which a correlation of the patient's aptitudes and remaining capabilities is attempted, was begun, and this has been a part of the Workshops' activities ever since. Here there is cheerful training under conditions closely approximating those of the business world. Raw goods are actually bought, manufactured and sold. Patients and trainees learn to type, mimeograph, do clerical work, prepare meals and run the telephone exchange.

The Community Workshops has now added to its activities a curative shop, giving physical and occupational therapy. This is in line with the Baruch Committee recommendations. Thus Boston now has in one place all the required facilities for physical and functional restoration, including industrial diagnosis, vocational training and job placement wherever possible. The Curative Shop is the result of recommendations by special committees of the Greater Boston Community Council after much study of local needs. Physicians, insurance companies, industrial concerns, other social agencies and departments of the Commonwealth concerned with rehabilitation also urged this recent expansion.

Our technicians are registered graduates of schools accredited by the American Medical Association; therefore, they give no treatments without written prescriptions from the patient's own physician. We believe that the patient continues to be the responsibility of his own physician, who receives periodical reports on the patient's condition and progress, re-examines the patient as frequently as desired, authorizes supplementary services and discharges the patient when maximum improvement is reached. Before acceptance for treatment or training, careful consideration is given to the needs of each applicant so that the patient will be likely to profit by the services of the Community Workshops. Admission policy is based on the Workshops' ability to help constructively rather than on the patient's ability to pay for service.

The Community Workshops is a nonprofit, Red Feather agency, in which patients who can afford to do so pay the cost of individual treatments, which ranges from $2.00 to $4.00, depending upon the amount of the technician's time and the equipment used.

Since the opening of the Curative Shop last summer, some of the groups that felt the need and urged the program have referred patients to us. Physicians have expressed themselves favorably concerning the quality of our personnel and equipment. The best thinking in the country seems to favor such a rehabilitation center as we are now operating. We have the impression, however, that there are many physicians whose attention, for one reason or another, has not been drawn to our enterprise. It is for this reason that we are venturing to send you this brief description of a going concern, in the heart of Boston, ready to administer to all comers and equipped to apply the best in physical, occupational and curative therapy. We welcome inquiries and visits from interested physicians and would be happy to have their patients in need of rehabilitation referred to us.

HAZEL NEWTON, *General Manager*
The Community Workshops
Boston

BOOK REVIEWS

Diseases of the Heart and Circulation. By Albert A. Fitzgerald Peel, M.A., D.M. (Oxon.), F.A.F.P.S.(G.) Cloth, 398 pp. with 155 illustrations. London: Oxford University Press, 1947. $9.75.

This volume, according to the author, is the outcome of fifteen years' experience in the teaching of medical students and is intended primarily as an introduction to the study of cardiovascular disease for students and practitioners. As such it is a readable book. It is divided logically into four main sections: symptoms and signs, anatomic lesions, etiology and treatment of cardiac failure. The format is excellent, and the illustrations are generous and, on the whole, good.

Nevertheless, for the present-day student of cardiovascular disease, this book leaves much to be desired. It reflects a pre-war point of view and for a volume published in 1947 is surprisingly lacking in emphasis, or even mention, of the notable progress of the past three or four years. For example, the section on electrocardiography takes little cognizance of the interest in and development of precordial and unipolar electrocardiograms. The illustrations consist mostly of the three conventional limb leads, with the occasional addition of a single precordial lead.

The remarkable results of penicillin therapy in bacterial endocarditis since 1944 are mentioned but largely relegated to a footnote. The use of dicumarol in thrombophlebitis and pulmonary embolism is briefly discussed, but surgical interruption of the leg veins (or of the vena cava) receives no consideration. The Blalock–Taussig operation for the relief of cyanosis in certain patients with congenital heart disease, although introduced in 1945, is not included.

To the reviewer the section on treatment of cardiac failure is inadequate. The importance of frequent weighing of the patient, the strict low-sodium diet and the use of oxygen for acute cardiovascular emergencies (either congestion or myocardial infarction) are omitted. There is, furthermore, an implication that maintenance of digitalis after congestive failure is often unnecessary.

Finally, the more experienced student of cardiovascular disease will raise serious objection to such statements as "protodiastolic gallop is the result of reduplication of the second sound" (Page 40) and "salicylates or aspirin in dosage similar to that employed in acute rheumatic fever usually produce marked benefit [in chorea]" (Page 216), as well as to the suggestion that cardiovascular syphilis may lead to the development of aortic stenosis (Page 221). The bibliography is meagre.

On the whole, this volume has little to recommend it, and for its modest size and content the price seems excessive.

The Echo. By Lilia Van Saher. 8°, cloth, 255 pp. New York: E. P. Dutton and Company, Incorporated, 1947. $2.75.

This is a brief but interesting story of the emotional turmoil and mental anguish in the life of a woman whose conduct is characterized by insecurity and uncertainty. Louise is the victim of shameful memories, which seem to tell her that she has forfeited all her rights to a mate and future happiness. There is a feeling of ambivalence toward her husband, for she believes that she loves him and yet is repelled by him.

This question is continually in the reader's mind, Can psychoanalysis help Louise, or is she to suffer forever because of her feelings of guilt?

There is an important message for all who are struggling for release, happiness, poise and inner security as they watch Louise find herself through psychoanalysis.

The Echo is a simple, authentic novel of a woman's deepest drives and frustrations. Through her visits to her analyst the reader is permitted to see psychoanalysis at work and what may be accomplished through this medium.

NOTICES

ANNOUNCEMENT

Dr. James J. O'Leary, Jr., announces the opening of his office at 97 Lincoln Street, Framingham, for the practice of surgery.

NEW ENGLAND DIABETES ASSOCIATION

The second annual meeting of the New England Diabetes Association will be held at the New England Deaconess Hospital, Boston, on Monday, May 24, from 4:00 to 5:30 p.m.

PROGRAM

Brief Business Session.

Clinical Demonstrations Illustrating the Treatment of Diabetes at the New England Deaconess Hospital:

- Transmetatarsal Amputation — Immediate and Remote Results.
- Diabetic Coma — 91 Successive Cases Without a Death, With Credit Due to Family Physician.
- Potassium Deficiency.
- Demonstration — Pregnant Diabetic Patients and Their Treatment.
- The Victory Medal for Diabetes of Twenty-Five Years' Duration With Onset Under Twenty-Five Years of Age With Freedom from Degenerative Vascular Lesions.
- Uric Acid Diabetes.
- Essentials of Treatment of Diabetes Today.

NEW ENGLAND ALUMNI OF BALTIMORE MEDICAL COLLEGE, COLLEGE OF PHYSICIANS AND SURGEONS AND UNIVERSITY OF MARYLAND MEDICAL SCHOOL

The annual luncheon meeting of the New England alumni of Baltimore Medical College, College of Physicians and Surgeons and University of Maryland Medical School, will be held at the University Club, 40 Trinity Place, Boston, on May 26, at 12:30 p.m. The section meetings and exhibits of the three-day annual meeting of the Massachusetts Medical Society at the Hotel Statler, beginning on May 25, will be open to visiting alumni. Reservations should be made before May 17 to the secretary-treasurer, Dr. Charles E. Gill, 184 North Street, Pittsfield, Massachusetts.

NEW ENGLAND HEALTH INSTITUTE

The 1948 New England Health Institute will be held at the University of Massachusetts campus at Amherst on June 16, 17 and 18. Programs have been mailed to five thousand local and state health-department workers in the six New England states.

Panel discussions on advances in local health services, chronic illness and health needs of children will be supplemented by the varied topics on the five section meetings arranged for June 17 by the Massachusetts Public Health Association.

At special dinner meetings on June 16 and 17 addresses by Dr. Leonard A. Scheele, surgeon-general of the United States Public Health Service, and John H. Crider, editor-in-chief of the *Boston Herald*, will be presented.

NEW ENGLAND SOCIETY OF ANESTHESIOLOGISTS

A meeting of the New England Society of Anesthesiologists will be held in the Bigelow Amphitheater of the White Building, Massachusetts General Hospital, Boston, on Tuesday, June 8, at 8 p.m. A scientific program will be presented by the Rhode Island Hospital group.

PROGRAM

Fluid Therapy. Russel O. Bowman, Ph.D.

Anesthesia for Hip-Nailing. E. F. Neves, M.D., and Margaret Iszard, M.D.

Some Considerations of Endotracheal Anesthesia. Clement S. Dwyer, M.D., and Sanford Kronenberg, M.D.

Physicians and medical students are invited to attend.

NATIONAL CONFERENCE OF COUNTY MEDICAL SOCIETY OFFICERS

The third National Conference of County Medical Society Officers will be held at the Palmer House, Chicago, on June 20 from 10 a.m. to 4 p.m.

Although the program is directed primarily to officers of county medical societies, any member of the American Medical Association is welcome to attend and participate in the discussion.

SOCIETY MEETINGS AND CONFERENCES

CALENDAR OF BOSTON DISTRICT FOR THE WEEK BEGINNING

THURSDAY, MAY 27

FRIDAY, MAY 28

*9:00–10:00 a.m. Some Actions of Folic Acid Conjugates and Antagonists on Malignant Tumors. Dr. Sidney Farber. Joseph H. Pratt Diagnostic Hospital.

*10:00 a.m.–12:00 m. Medical Staff Rounds. Peter Bent Brigham Hospital.

TUESDAY, JUNE 1

*12:00 m. X-ray Conference. Margaret Jewett Hall, Mt. Auburn Hospital, Cambridge.

*12:15–1:15 p.m. Clinicoroentgenological Conference. Peter Bent Brigham Hospital.

*1:30–2:30 p.m. Pediatric Rounds. Burnham Memorial Hospital for Children, Massachusetts General Hospital.

WEDNESDAY, JUNE 2

*12:00 m. Grand Rounds and Clinicopathological Conference. (Children's Hospital.) Amphitheater, Peter Bent Brigham Hospital.

*2:00–3:00 p.m. Combined Clinic by the Medical, Surgical and Orthopedic Services. Amphitheater, Children's Hospital.

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*Open to the medical profession.

MAY 20–25. American Board of Ophthalmology. Page 170, issue of January 29.

MAY 23–28. American Physiotherapy Association. Page 543, issue of April 8.

MAY 24. New England Diabetes Association. Notice above.

MAY 24. New England Heart Association. Page 722, issue of May 13.

MAY 24–26. American Gynecological Society. Page 543, issue of April 8.

MAY 24–27. Massachusetts Medical Society. Annual Meeting. Hotel Statler, Boston.

MAY 25–27. Massachusetts Physicians' Art Association. Page 722, issue of May 13.

MAY 26. Massachusetts Medico-Legal Society. Page 678, issue of May 6.

MAY 26. New England Alumni of Baltimore Medical College, College of Physicians and Surgeons and University of Maryland Medical School. Notice above.

MAY 27–29. American Surgical Association. Page 455, issue of March 25.

JUNE 2. Children's Hospital Alumni Association. Page 648, issue of April 29.

JUNE 3–6. American Orthopaedic Association. Page 614, issue of May 6.

JUNE 7–10. National Gastroenterological Association. Page 455, issue of March 25.

JUNE 8. New England Society of Anesthesiologists. Notice above.

JUNE 11. Harvard Medical School Class of 1898. Page 722, issue of May 13.

JUNE 14–16. American Neurological Association. Page 582, issue of April 15.

(*Notices concluded on page xix*)